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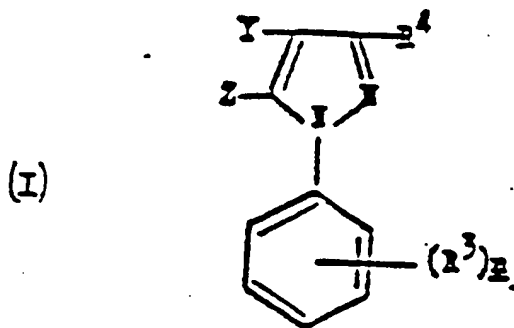
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(54) Title: PESTICIDAL METHOD USING N-PHENYLPYRAZOLES



(57) Abstract

A method for the control of arthropod, plant nematode or helminth pests using compounds of formula (I), wherein Y is halogen, cyano, nitro, RSO<sub>2</sub>, RSO or RS in which R is alkyl, cycloalkyl or alkenyl, thiocyanato, sulphamoyl, carbamoyl, alkoxy carbonyl, alkanoyl or alkyl; Z represents hydrogen, an amino group -NR<sup>1</sup>R<sup>2</sup>, alkylsulphenylamino, alkoxymethyleneamino, halogen, alkyl, carboxy, alkylthio, alkylsulphanyl or alkylsulphonyl, trialkylsilylmethyl, trialkylsilyl, cyano or nitro; R<sup>3</sup> represents halogen, alkyl or alkoxy, halogen-substituted alkylthio or alkylsulphanyl, nitro, cyano, or alkylsulphonyl; and R<sup>4</sup> represents halogen, cyano, nitro, alkyl or cycloalkyl, and n is 1 to 5, and salts thereof, provided that R<sup>4</sup>, Y and Z do not simultaneously represent one of nitro, cyano, halogen and unsubstituted alkyl; pesticidal compositions, novel compounds and processes for their preparation are described.

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DESCRIPTION

"PESTICIDAL METHOD USING N-PHENYLPYRAZOLES"

This invention relates to the use of N-phenylpyrazole derivatives against arthropod, plant  
5 nematode and helminth pests, to compositions containing them and to novel N-phenylpyrazole derivatives.

In J. Heter. Chem., 12 (1975), 1199-1205, P.L. Southwick and B. Dhawan have described  
10 experiments for the preparation of 4,6-diamino-pyrazolo[3,4-d]pyrimidines in the expectation that such pyrimidine derivatives would have useful pharmacological properties. They employed as starting materials 5-amino-4-cyanopyrazoles  
15 carrying on the 1-position a hydrogen atom, a methyl group, a hydroxyethyl group or a phenyl group substituted by one or more chlorine atoms and/or methyl groups, and on the 3-position a hydrogen atom, a methyl group or a phenyl or benzyl group. This  
20 publication contains no suggestion that compounds of general formula I possess or would be expected to possess activity against arthropods, helminths or plant nematodes.

Apparently these pyrazole compounds did not lead  
25 (according to the authors of the article) to useful therapeutic (viz. antimalarial) 4,6-diaminopyrazolo[3,4-d]pyrimidines.

US Patent No. 3760084 describes certain  
5-amino-1-phenyl-pyrazoles as being useful for  
ameliorating inflammation in warm-blooded animals: the  
compounds carry on the 3-position hydrogen or a lower  
alkyl group and on the 4-position a carbamoyl or  
cyano group.

US Patent No. 3869274 describes certain  
4-nitropyrazoles as being useful for the induction of  
abscission of fruit from fruit-bearing plants.

US Patent No. 4066776 describes a very extensive  
group of 1,4-disubstituted-3-nitropyrazoles as having  
antimicrobial, parasiticidal and herbicidal  
properties: the great biological activity of the  
compounds is stated to be limited to the  
3-nitropyrazoles disclosed, the characterising feature  
of the compounds being the 3-nitropyrazole nucleus.

Japanese Patent Publication No. 12644/64 describes  
a process for the preparation of 4-thiocyanatopyrazole  
derivatives which are stated to be useful as  
germicides.

Japanese Patent Publication No. 49-117502  
describes certain pyrazole sulphonamides having  
anti-thrombogenic properties.

None of the foregoing publications describes or  
suggests that compounds of general formula I possess  
or would be expected to possess the activity against  
arthropods, helminths or plant nematodes which has  
been discovered by the Applicants.

It has now unexpectedly been found after extensive research and experimentation that the N-phenylpyrazole derivatives of the general formula I depicted hereinafter wherein Y represents a halogen, i.e. fluorine, chlorine, bromine or iodine, atom, the cyano or nitro group or a group  $\text{RSO}_2$ ,  $\text{RSO}$  or  $\text{RS}$  in which R represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms, a cycloalkyl group containing from 3 to 5 carbon atoms, a straight- or branched-chain alkenyl group containing from 2 to 6 carbon atoms, the thiocyanato group, the sulphamoyl group which may be unsubstituted or substituted by one or two straight- or branched-chain alkyl groups which may be the same or different and contain from 1 to 6 atoms, the carbamoyl group which may be unsubstituted or substituted by one or two straight- or branched-chain alkyl groups which may be the same or different and contain from 1 to 6 carbon atoms, a straight- or branched-chain alkoxycarbonyl group containing from 2 to 7 carbon atoms, a straight- or branched-chain alkanoyl group containing from 2 to 7 carbon atoms, or a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms,

Z represents the hydrogen atom, or the amino group  
-NR<sup>1</sup>R<sup>2</sup> wherein R<sup>1</sup> and R<sup>2</sup>, which may be the  
same or different, each represents a hydrogen atom or  
a straight- or branched-chain alkyl group (containing  
from 1 to 6 carbon atoms, and which may be  
unsubstituted or substituted by straight- or  
branched-chain alkoxycarbonyl of 2 to 5 carbon atoms),  
cycloalkyl group containing from 3 to 6 carbon atoms,  
formyl group, straight- or branched-chain alkanoyl  
group (which contain from 2 to 7 carbon atoms or  
together form a 5 or 6 membered cyclic imide with the  
nitrogen atom to which they are attached and  
themselves may be unsubstituted or substituted by one  
or more halogen atoms) or cycloalkylcarbonyl group  
(which contain from 4 to 7 carbon atoms) or straight-  
or branched-chain alkoxycarbonyl groups (which contain  
from 2 to 7 carbon atoms and themselves are  
unsubstituted or substituted by one or more halogen  
atoms), or Z represents a straight- or branched-chain  
alkylsulphenylamino group containing from 1 to 4  
carbon atoms, a straight- or branched-chain  
alkoxymethyleneamino group containing from 2 to 5  
carbon atoms which may be unsubstituted or substituted  
on methylene by a straight- or branched-chain alkyl  
group containing from 1 to 4 carbon atoms, or  
represents a halogen, i.e. fluorine, chlorine, bromine  
or iodine, atom, a straight- or branched-chain alkyl  
group containing from 1 to 4 carbon atoms, the carboxy

group, or a straight- or branched-chain alkylthio, alkylsulphinyl or alkylsulphonyl group containing from 1 to 6 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms, or

5 represents a straight- or branched-chain trialkylsilylmethyl group containing from 1 to 6 carbon atoms in each alkyl group which may be the same or different, a trialkylsilyl group containing from 1 to 6 carbon atoms in each alkyl group which may be

10 the same or different or the cyano or nitro group.  $R^3$  represents a halogen, i.e. fluorine, chlorine, bromine or iodine atom, a straight- or branched-chain alkyl or alkoxy group containing from 1 to 4 carbon atoms which may be unsubstituted or substituted by one

15 or more halogen atoms, (e.g. a trifluoromethyl or trifluoromethoxy group), a straight- or branched-chain alkylthio or alkylsulphinyl group containing from 1 to 4 carbon atoms which is substituted by one or more halogen atoms (e.g. a trifluoromethylthio or

20 trifluoromethylsulphinyl group), the nitro or cyano group or a straight- or branched-chain alkylsulphonyl group containing from 1 to 4 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms (e.g. the trifluoromethylsulphonyl group), and

25  $R^4$  represents a halogen, i.e. fluorine, chlorine, bromine or iodine, atom, a cyano or nitro group or a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms which may be unsubstituted or



substituted by one or more halogen atoms, or a cycloalkyl group containing from 3 to 6 carbon atoms, and  $n$  represents an integer from 1 to 5 inclusive, and, when Z represents a carboxy group, salts thereof with pesticidally-acceptable bases provided that  $R^4$ , Y and Z do not simultaneously represent three groups of the same genus selected from the genera (i) nitro, (ii) cyano, (iii) halogen and (iv) unsubstituted alkyl, have valuable activity against arthropod, plant nematode and helminth pests, more particularly by ingestion of the compound(s) of general formula I by the arthropods. When  $n$  represents an integer from 2 to 5 inclusive, atoms and groups represented by  $R^3$  may be the same or different.

By the term 'salts with pesticidally acceptable bases' is meant salts the cations of which are known and accepted in the art for the formation of salts of pesticidally active acids for agricultural or horticultural use. When intended for application to vertebrates to combat infection or infestation by arthropods or helminths, the salts with bases used will be non-toxic. By the term 'non-toxic' is meant salts with bases the cations of which are innocuous to the vertebrates at the doses administered and which do not vitiate the beneficial effects produced by the anion.

- 1 -  
Preferably, the salts are water-soluble.

Suitable salts with bases include alkali metal (e.g. sodium and potassium), alkaline earth metal (e.g. calcium and magnesium), ammonium and amine (e.g. diethanolamine, triethanolamine, octylamine, morpholine and dioctylmethylaniline) salts. It is to be understood that where reference is made in the present specification to the compounds of general formula I such reference is intended to include also the salts with pesticidally acceptable bases of compounds of general formula I where appropriate.

Preferred compounds of general formula I are those with phenyl substitution which is 2,4,6-trichloro, 2,3,5,6-tetrachloro, 2-chloro-4-trifluoromethyl, 2,3,5,6-tetrafluoro-4-trifluoromethyl, 2,6-dichloro-4-trifluoromethylthio, 2-chloro-3,5,6-trifluoro-4-trifluoromethyl, 2,6-dichloro-3,5-difluoro-4-trifluoromethyl, 2,6-dichloro-4-nitro, 2,6-dichloro-4-trifluoromethylsulphanyl, 2,6-dichloro-4-methanesulphonyl and 2,6-dichloro-4-trifluoromethanesulphonyl.

Compounds of general formula I wherein  $(R^3)_n$  represents 2,6-dichloro-4-trifluoromethyl or 2,6-dichloro-4-trifluoromethoxy substitution of the phenyl group are especially preferred.

Preferred compounds are those where

- 5 (a) Y and R<sup>4</sup> each represent a cyano group and  
Z represents the hydrogen atom, the amino group  
-NR<sup>1</sup>R<sup>2</sup> or an alkylsulphenylamino group, an  
alkoxymethyleneamino group which may be  
unsubstituted or substituted on methylene by an  
alkyl group, a halogen atom, an alkyl group, the  
carboxy group, an alkylthio, alkylsulphinyl or  
alkylsulphonyl group which is optionally halogen  
10 substituted, a trialkylsilylmethyl group, a  
trialkylsilyl group or the nitro group;
- (b) Y represents an alkylsulphonyl group which is  
optionally halogen substituted, a  
cycloalkylsulphonyl group or an alkenylsulphonyl  
15 group, Z represents the hydrogen atom, the amino  
group -NR<sup>1</sup>R<sup>2</sup> or an alkylsulphenylamino group,  
an alkoxymethyleneamino group which is  
unsubstituted or substituted on methylene by an  
alkyl group, a halogen atom, an alkyl group, the  
20 carboxy group, an alkylthio, alkylsulphinyl or  
alkylsulphonyl group which is optionally halogen  
substituted, a trialkylsilylmethyl group, a  
trialkylsilyl group or the cyano or nitro group  
and R<sup>4</sup> represents a halogen atom or the cyano  
25 or nitro group;

(c)  $R^4$  represents the nitro group, Y represents the cyano or nitro group, a carbamoyl group or an alkoxycarbonyl group and

Z represents the hydrogen atom, a halogen atom, an alkyl group, the carboxy group, an alkylthio, alkylsulphinyl or alkylsulphonyl group which is optionally halogen substituted,

a trialkylsilylmethyl group, a trialkylsilyl group or the nitro group;

(d)  $R^4$  represents a halogen atom, Y represents the cyano or nitro group, a carbamoyl group or an alkoxycarbonyl group and

Z represents the hydrogen atom, the amino group  $-NR^1R^2$  or an alkylsulphenylamino group, an

alkoxymethyleneamino group which is unsubstituted or substituted on methylene by an alkyl group, a halogen atom, an alkyl group, the carboxy group, an alkylthio, alkylsulphinyl or alkylsulphonyl group which is optionally halogen substituted, a trialkylsilylmethyl group, a trialkylsilyl group or the nitro group; and

(e)  $R^4$  represent an alkyl group which is unsubstituted or substituted by one or more halogen atoms or a cycloalkyl group, Y represents a halogen atom, the cyano or nitro group, a group  $RSO_2$ ,  $RSO$  or  $RS$ , the thiocyanato group, a sulphamoyl group, a carbamoyl group, an

alkoxy carbonyl group, an alkanoyl group or an alkyl group which is unsubstituted or substituted by one or more halogen atoms,

5 Z represents the hydrogen atom, the amino group  $-NR^1R^2$  or an alkylsulphenylamino group, an alkoxymethyleneamino group which is unsubstituted or substituted on methylene by an alkyl group, a halogen atom, an alkyl group, the carboxy group, an alkylthio, alkylsulphinyl or alkylsulphonyl  
10 group which is optionally halogen substituted, a trialkylsilylmethyl group, a trialkylsilyl group or the cyano or nitro group.

It will be appreciated that the groups listed above are as hereinbefore defined earlier in the  
15 specification.

Compounds of general formula I wherein  $R^4$  represents a trifluoromethyl or methyl group are also preferred.

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Compounds of general formula I which are of particular interest against arthropods are:

- 1 5-Amino-3,4-dicyano-1-(2,4,6-trichlorophenyl)pyrazole
- 5 2 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole
- 3 5-Amino-3,4-dicyano-1-(2,3,5,6-tetrachlorophenyl)pyrazole
- 4 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole
- 10 5 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 6 5-Amino-3-chloro-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole
- 15 7 5-Amino-3-bromo-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole
- 8 5-Amino-3-iodo-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole
- 9 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-ethanesulphenylamino-pyrazole
- 20 10 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-methoxymethyleneamino-pyrazole

- 11 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-5-propoxymethyleneamino-pyrazole
- 5 12 5-Acetamido-1-(2,6-dichloro-4-trifluoro-methylphenyl)-3,4-dicyanopyrazole
- 13 5-Dichloroacetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole
- 14 5-Cyclopropylcarbonamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole
- 10 15 5-Pentanamido-1-(2,6-dichloro-4-trifluoro-methylphenyl)-3,4-dicyanopyrazole
- 16 5-Propionamido-1-(2,6-dichloro-4-trifluoro-methylphenyl)-3,4-dicyanopyrazole
- 17 5-Amino-1-(2-chloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole
- 15 18 5-Amino-3,4-dicyano-1-(2,3,5,6-tetrafluoro-4-trifluoromethylphenyl)pyrazole
- 19 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoro-methylphenyl)-3-pentafluoroethylpyrazole
- 20 20 5-Amino-3-chlorodifluoromethyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole
- 21 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-cyano-3-difluoromethylpyrazole
- 25 22 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-methanesulphonyl-3-trifluoro-methylpyrazole

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- 23 5-Amino-4-carbamoyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 5 24 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methoxycarbonyl-3-trifluoromethylpyrazole
- 25 5-Acetamido-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 10 26 1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-(2,2-dimethylpropionamido)-pyrazole
- 15 27 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-ethoxymethyleneamino-3-trifluoromethylpyrazole
- 28 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-dimethylamino-3-trifluoromethylpyrazole
- 20 29 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-ethoxycarbonylmethylamino-3-trifluoromethylpyrazole
- 30 4-Cyano-5-methylamino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 25 31 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-(2,2-dimethylpropionamido)-3-trifluoromethylpyrazole



- 32 5-Amino-4-bromo-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 5 33 5-Bromo-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 34 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-fluoromethylpyrazole
- 10 35 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole
- 36 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethoxyphenyl)-3-trifluoromethylpyrazole
- 15 37 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(ethoxycarbonyl)amino-3-trifluoromethylpyrazole
- 38 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(cyclopropanecarbonyl)amino-3-trifluoromethylpyrazole
- 20 39 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-cyclopropanecarbonamido-3-trifluoromethylpyrazole
- 25 40 5-Amino-4-chloro-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole

- 41 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-5-ethoxycarbonylamino-3-trifluoromethylpyrazole
- 5 42 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-trifluoromethylpyrazole
- 43 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-5-iodo-3-trifluoromethylpyrazole
- 44 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-5-methyl-3-trifluoromethylpyrazole
- 10 45 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-(N,N-dimethylsulphamoyl)-3-trifluoromethylpyrazole
- 46 5-Amino-4-cyano-3-cyclopropyl-1-(2,6-dichloro-4-trifluoromethyl-phenyl)pyrazole
- 15 47 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-heptafluoropropylpyrazole
- 48 5-Amino-3,4-dicyano-1-(2,6-dichloro-4-trifluoromethylthiophenyl)pyrazole
- 20 49 5-Amino-1-(2-chloro-3,5,6-trifluoro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole,
- 50 5-Amino-1-(2,6-dichloro-3,5-difluoro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole,
- 25 51 5-Amino-1-(2,6-dichloro-4-trifluoromethoxyphenyl)-3,4-dicyanopyrazole,
- 52 5-Amino-4-cyano-3-ethyl-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole

53 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-methanesulphonyl-3-methylpyrazole

54 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-ethoxycarbonylpyrazole

55 5-Amino-1-(2,6-dichloro-4-trifluoromethoxy-phenyl)-4-methanesulphonyl-3-methylpyrazole

56 5-Amino-1-(2-chloro-3,5,6-trifluoro-4-trifluoromethylphenyl)-4-cyano-3-trifluoro-methylpyrazole

57 5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoro-methylthiophenyl)-3-trifluoromethylpyrazole

58 5-Amino-3-chlorofluoromethyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole

59 5-Amino-4-cyano-1-(2,6-dichloro-3,5-difluoro-4-trifluoromethylphenyl)-3-trifluoromethyl-pyrazole

60 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-5-(1-ethoxyethylideneamino)-3-methylpyrazole

61 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-5-succinimidopyrazole

62 5-Acetamido-1-(2,6-dichloro-4-trifluoro-methylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole

63 5-Acetamido-1-(2,6-dichloro-4-trifluoro-methylphenyl)-3-methyl-4-methanesulphonyl-pyrazole

- 5
- 64 5-Amino-1-(2,6-dichloro-4-nitrophenyl)-  
3,4-dicyanopyrazole
- 65 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
3,4-dicyano-5-methylaminopyrazole
- 66 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
3,4-dicyano-5-ethylaminopyrazole
- 67 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-5-(N-methyl-N-ethoxycarbonylamino)-  
3-trifluoromethylpyrazole
- 10
- 68 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-5-(N-acetyl-N-trimethylacetylamino)-  
3-trifluoromethylpyrazole
- 69 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-5-(N-propionyl-N-trimethylacetylamino)-  
3-trifluoromethylpyrazole
- 15
- 70 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
4-nitro-3-trifluoromethyl-5-trimethyl-  
acetylamino-pyrazole
- 20
- 71 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
5-ethoxycarbonylamino-4-nitro-3-trifluoromethyl-  
pyrazole
- 25
- 72 3-Chloro-1-(2,6-dichloro-4-trifluoro-  
methylphenyl)-4-cyano-5-trimethylacetyl-  
aminopyrazole
- 73 3-Chloro-1-(2,6-dichloro-4-trifluoro-  
methylphenyl)-4-cyano-5-bis(ethoxy-  
carbonyl)aminopyrazole

- 74 3-Chloro-1-(2,6-dichloro-4-trifluoro-  
methylphenyl)-4-cyano-5-ethoxycarbonyl-  
aminopyrazole
- 5 75 4-Cyano-5-diacetylamino-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoro-  
methylpyrazole
- 76 5-(N-Acetyl-N-ethoxycarbonylamino)-  
4-cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-trifluoromethylpyrazole
- 10 77 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
5-bis(ethoxycarbonyl)amino-3,4-dicyano-  
pyrazole 10
- 15 78 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
5-bis(ethoxycarbonyl)amino-4-methane-  
sulphonyl-3-trifluoromethylpyrazole 15
- 79 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
5-ethoxycarbonylamino-4-methanesulphonyl-  
3-trifluoromethylpyrazole
- 20 80 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
3,4-dicyano-5-ethoxycarbonylaminopyrazole 20
- 81 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-4-iodo-3-trifluoromethylpyrazole
- 82 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-4-iodo-3-methylpyrazole
- 25 83 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-methyl-4-nitropyrazole 25

- 84 5-Acetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole
- 5 85 1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole
- 86 1-(2,6-Dichloro-4-trifluoromethylphenyl)-3-methyl-4-methanesulphonylpyrazole
- 87 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-fluoropyrazole
- 10 88 1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole
- 89 5-Chloro-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-trifluoromethylpyrazole
- 15 90 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-(N-ethylsulphamoyl)-3-trifluoromethylpyrazole
- 91 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-(N-methylsulphamoyl)-3-trifluoromethylpyrazole
- 20 92 1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-cyano-3-nitropyrazole
- 93 1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-nitropyrazole
- 25 94 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-fluoropyrazole

- 95 5-Amino-3-chloro-1-(2,6-dichloro-4-trifluoromethoxyphenyl)-4-cyanopyrazole
- 96 5-Amino-3-chloro-4-cyano-1-(2,6-dichloro-3,5-difluoro-4-trifluoromethylphenyl)pyrazole
- 5 97 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethyl-5-trimethylsilylpyrazole
- 10 98 5-tert-Butyldimethylsilyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 99 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methylthio-3-trifluoromethylpyrazole
- 15 100 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethyl-5-trifluoromethylthiopyrazole
- 20 101 5-Carboxy-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole
- 102 1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethyl-5-trimethylsilylpyrazole
- 25 103 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethyl-5-trimethylsilylmethylpyrazole

4,4 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-5-methoxycarbonylamino-  
3-trifluoromethylpyrazole

5 4,5 1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
4,5-dicyano-3-trifluoromethylpyrazole

106 5-Amino-3-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-4-methane-  
sulphonylpyrazole

10 107 4-Acetyl-1-(2,6-dichloro-4-trifluoro-  
methylphenyl)-3-trifluoromethylpyrazole

108 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-4-methylsulphonyl-3-trifluoro-  
methylpyrazole

15 109 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-4-ethylsulphonyl-3-trifluoro-  
methylpyrazole

110 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-4-ethylsulphonyl-3-methylpyrazole

20 111 5-Amino-4-cyano-1-(2,6-dichloro-  
4-trifluoromethylsulphonylphenyl)-  
3-trifluoromethylpyrazole

112 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-5-methylsulphonyl-3-trifluoro-  
methylpyrazole

25 113 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-4-ethylsulphonyl-3-trifluoro-  
methylpyrazole



- 114 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-ethylsulphonyl-3-methylpyrazole
- 115 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-propanesulphonyl-pyrazole
- 116 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-trichloromethanesulphonyl-3-methylpyrazole
- 117 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-ethylthio-3-methylpyrazole
- 118 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-methylthiopyrazole
- 119 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-n-propylthio-3-methylpyrazole
- 120 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-ethylthio-3-trifluoromethyl-pyrazole
- 121 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-methylthio-3-trifluoromethyl-pyrazole
- 122 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-thiocyanato-3-trifluoromethyl-pyrazole
- 123 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-thiocyanatopyrazole

- 124 5-Amino-4-cyano-1-(2,6-dichloro-4-methanesulphonylphenyl)-3-trifluoromethylpyrazole
- 5 125 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-trichloromethylthiopyrazole
- 126 4-Cyano-1-(2,6-dichloro-4-trifluoromethanesulphonylphenyl)-5-nitro-3-trifluoromethylpyrazole
- 10 127 1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-difluoromethyl-3-trifluoromethylpyrazole
- 128 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methyl-3-trifluoromethylpyrazole
- 15

The numbers 1 to 128 are assigned to the above compounds for identification and reference hereinafter.

Especially preferred compounds of general formula I are numbered:-

20 2; 22; 37; 53; 71; 106 and 118.

According to a feature of the present invention, there is provided a method for the control of arthropod, plant nematode or helminth pests at a locus which comprises the treatment of the locus (e.g. by application or administration) with an effective amount of a compound of general formula I, or a pesticidally acceptable salt thereof, wherein the various symbols are as hereinbefore defined. The compounds of general formula I may, in particular, be used in the fields of veterinary medicine and livestock husbandry and in the maintenance of public health against arthropods or helminths which are parasitic internally or externally upon vertebrates, particularly warm-blooded vertebrates, for example man and domestic animals, e.g. cattle, sheep, goats, equines, swine, poultry, dogs, cats and fishes, for example Acarina, including ticks (e.g. Ixodes spp., Boophilus spp. e.g. Boophilus microplus, Amblyomma spp., Hyalomma spp., Rhipicephalus spp. e.g. Rhipicephalus appendiculatus, Haemaphysalis spp., Dermacentor spp., Ornithodoros spp. (e.g. Ornithodoros moubata) and mites (e.g. Damalinia spp., Dermanyssus gallinae, Sarcoptes spp. e.g. Sarcoptes scabiei, Psoroptes spp., Chorioptes spp., Demodex spp., Eutrombicula spp.); Diptera (e.g. Aedes spp., Anopheles spp., Musca spp., Hypoderma spp., Gasterophilus spp., Simulium spp.);

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Hemiptera (e.g. Triatoma spp.); Pachiraptera (e.g. Damalinia spp., Linognathus spp.); Siphonaptera (e.g. Ctenocephalides spp.); Dictyoptera (e.g. Periplaneta spp., Blattella spp.); Hymenoptera (e.g. Monomorium pharaonis); for example against infections of the gastro-intestinal tract caused by parasitic nematode worms, for example members of the family Trichostrongylidae, Nippostrongylus brasiliensis, Trichinella spiralis, Haemonchus contortus, Trichostrongylus colubriformis, Nematodirus battus, Ostertagia circumcincta, Trichostrongylus axei, Cooperia spp. and Hymenolepis nana; in the protection of stored products, for example cereals, including grain and flour, groundnuts, animal feedstuffs, timber and household goods, e.g. carpets and textiles, against attack by arthropods, more especially beetles, including weevils, moths and mites, for example Ephestia spp. (flour moths), Anthrenus spp. (carpet beetles), Tribolium spp. (flour beetles), Sitophilus spp. (grain weevils) and Acarus spp. (mites), in the control of cockroaches, ants and similar arthropod pests in infested domestic and industrial premises and in the control of mosquito larvae in waterways, wells, reservoirs or other running or standing water; in agriculture, against adults, larvae and eggs of Lepidoptera (butterflies and moths), e.g. Heliothis spp. such as Heliothis virescens (tobacco budworm).

Heliothis armigera and Heliothis zea, Secodontera spp.  
 such as S.exempta, S.littoralis (Egyptian cotton  
 worm), S.ericidania (southern army worm), Mamestra  
configurata (bertha army worm); Earias spp. e.g.  
 5 E.insulana (Egyptian bollworm), Pectinophora spp. e.g.  
Pectinophora gossypiella (pink bollworm), Ostrinia  
 spp. such as O.nubilalis (European cornborer),  
Trichoplusia ni (cabbage looper), Pieris spp. (cabbage  
 worms), Laphygma spp. (army worms), Agrotis and  
 10 Amathes spp. (cutworms), Wiseana spp. (porina moth),  
Chilo spp. (rice stem borer), Trypoxyna spp. and  
Diatraea spp. (sugar cane borers and rice borers),  
Sparganothis pilleriana (grape berry moth), Cydia  
pomonella (codling moth), Archips spp. (fruit tree  
 15 tortrix moths), Plutella xylostella (diamond back  
 moth); against adults and larvae of Coleoptera  
 (beetles) e.g. Hypothenemus hampei (coffee berry  
 borer), Hylesinus spp. (bark beetles), Anthonomus  
grandis (cotton boll weevil), Acalymma spp. (cucumber  
 20 beetles), Lema spp., Psylliodes spp., Lectinotarsa  
decemlineata (Colorado potato beetle), Diabrotica spp.  
 (corn rootworms), Gonocephalum spp. (false wire  
 worms), Agriotes spp. (wireworms), Dermolepida and  
Heteronychus spp. (white grubs), Phaedon cochleariae  
 25 (mustard beetle), Lissorhynchus oryzoophilus (rice  
 water weevil), Meligethes spp. (pollen beetles),

Ceutorhynchus spp., Rhynchophorus and Cosmopolites spp. (root weevils); against Hemiptera e.g. Psylla spp., Bemisia spp., Aphis spp., Myzus spp., Macoura viciae, Phylloxera spp., Adelges spp., Phorodon humuli (hop damson aphid), Aeneclamia spp., Nephotettix spp. (rice leaf hoppers), Empoasca spp., Nilaparvata spp., Perkinsiella spp., Pyrilla spp., Aonidiella spp. (red scales), Coccus spp., Pseudococcus spp., Helopeltis spp. (mosquito bugs), Lygus spp., Dysdercus spp., Oxycarenus spp., Nezara spp.; Hymenoptera e.g. Athalia spp. and Cephus spp. (saw flies), Atta spp. (leaf cutting ants); Diptera e.g. Hylemyia spp. (root flies), Atherixona spp. and Chlorops spp. (shoot flies), Phytomyza spp. (leaf miners), Ceratitis spp. (fruit flies); Thysanoptera such as Thrips tabaci; Orthoptera such as Locusta and Schistocerca spp. (locusts) and crickets e.g. Gryllus spp. and Acheta spp.; Collembola e.g. Sminthurus spp. and Onychiurus spp. (springtails), Isoptera e.g. Odontotermes spp. (termites), Dermaptera e.g. Forficula spp. (earwigs) and also other arthropods of agricultural significance such as Acari (mites) e.g. Tetranychus spp., Panonychus spp. and Bryobia spp. (spider mites), Eriophyes spp. (gall mites), Polyphagotarsonemus spp.; Blaniulus spp. (millipedes), Scutigerella spp. (symphilids), Oniscus spp. (woodlice) and Triops spp. (crustacea); nematodes which attack plants and trees of importance to

agriculture, forestry, horticulture either directly or by spreading bacterial, viral, mycoplasma or , fungal diseases of the plants, root-knot nematodes such as Meloidogyne spp. (e.g. M. incognita); cyst nematodes such as Globodera spp. (e.g. G. rostochiensis); Heterodera spp. (e.g. H. avenae); Radopholus spp. (e.g. R. similis); lesion nematodes such as Pratylenchus spp. (e.g. P. pratensis); Belonolaimus spp. (e.g. B. gracilis); Tylenchulus spp. (e.g. T. semipenetrans); Rotylenchulus spp. (e.g. R. reniformis); Rotylenchus spp. (e.g. R. robustus); Helicotylenchus spp. (e.g. H. multicinctus); Hemicycliophora spp. (e.g. H. gracilis); Criconeoides spp. (e.g. C. similis); Trichodorus spp. (e.g. T. primitivus); dagger nematodes such as Xiphinema spp. (e.g. X. diversicaudatum), Longidorus spp. (e.g. L. elongatus); Hoplolaimus spp. (e.g. H. coronatus); Aphelenchoides spp. (e.g. A. ritzena-bosi, A. bessevi); stem and bulb eelworms such as Ditylenchus spp. (e.g. D. dipsaci).

The invention also provides a method for the control of arthropod or nematode pests of plants which comprises the application to the plants or to the medium in which they grow of an effective amount of a compound of general formula I or a pesticidally acceptable salt thereof.

or  
1  
The compounds of general formula I may be applied  
in solid or liquid compositions to the soil principally  
to control those nematodes dwelling therein but also to  
the foliage principally to control those nematodes  
5 attacking the aerial parts of the plants (e.g.  
-g.  
Aphelenchoides spp. and Ditylenchus spp. listed above).

The compounds of general formula I are of value in  
controlling pests which feed on parts of the plant  
remote from the point of application, e.g. leaf feeding  
10 insects are killed by the subject compounds applied to  
roots.

In addition the compounds may reduce attacks on the  
plant by means of antifeeding or repellant effects.

The compounds of general formula I are of  
15 particular value in the protection of field, forage,  
plantation, glasshouse, orchard and vineyard crops, of  
ornamentals and of plantation and forest trees, for  
example, cereals (such as maize, wheat, rice,  
sorghum), cotton, tobacco, vegetables and salads (such  
20 as beans, cole crops, curcurbits, lettuce, onions,  
tomatoes and peppers), field crops (such as potato,  
sugar beet, ground nuts, soyabean, oil seed rape),  
sugar cane, grassland and forage (such as maize,  
sorghum, lucerne), plantations (such as of tea,  
25 coffee, cocoa, banana, oil palm, coconut, rubber,



5 ornamentals and groves (such as of stone and pip fruit, citrus, kiwifruit, avocado, mango, olives and walnuts), vineyards, ornamental plants, flowers and shrubs under glass and in gardens and parks, forest trees (both deciduous and evergreen) in forests, plantations and nurseries.

10 They are also valuable in the protection of timber (standing, felled, converted, stored or structural) from attack by sawflies (e.g. Urocerus) or beetles (e.g. scolytids, platypodids, lyctids, bostrychids, cerambycids, anobiids).

15 They have applications in the protection of stored products such as grains, fruits, nuts, spices and tobacco, whether whole, milled or compounded into products, from moth, beetle and mite attack. Also protected are stored animal products such as skins, hair, wool and feathers in natural or converted form (e.g. as carpets or textiles) from moth and beetle attack; also stored meat and fish from beetle, mite and fly attack.

20 The compounds of general formula I are of particular value in the control of arthropods or helminths which are injurious to, or spread or act as vectors of diseases in man and domestic animals, for example those hereinbefore mentioned, and more especially in the control of ticks, mites, lice, fleas, midges and biting, nuisance and myiasis

flies. The compounds of general formula I are particularly useful in controlling arthropods or helminths which are present inside domestic host animals or which feed in or on the skin or suck the blood of the animal, for which purpose they may be administered orally, parenterally, percutaneously or topically.

The compositions hereinafter described for topical application to man and animals and in the protection of stored products, household goods, property and areas of the general environment may, in general, alternatively be employed for application to growing crops and crop growing loci and as a seed dressing.

Suitable means of applying the compounds of general formula I include:-

to persons or animals infested by or exposed to infestation by arthropods or helminths, by parenteral, oral or topical application of compositions in which the active ingredient exhibits an immediate and/or prolonged action over a period of time against the arthropods or helminths, for example by incorporation in feed or suitable orally-ingestible pharmaceutical formulations, edible baits, salt licks, dietary supplements, pour-on formulations, sprays, baths, dips, showers, jets, dusts, greases, shampoos, creams, wax-smears and livestock self-treatment systems;

environment in general or to specific  
locations where pests may lurk, including stored  
products, timber, household goods, and domestic  
and industrial premises, as sprays, fogs, dusts,  
smokes, wax-smears, lacquers, granules and baits,  
and in tricklefeeds to waterways, wells,  
reservoirs and other running or standing water;  
to domestic animals in feed to control fly larvae  
feeding in their faeces.

The compounds of general formula I may be applied  
to control arthropods or helminths in compositions of  
any type known to the art suitable for internal or  
external administration to vertebrates or application  
for the control of arthropods in any premises or  
indoor or outdoor area, containing as active  
ingredient at least one compound of general formula I  
in association with one or more compatible diluents or  
adjuvants appropriate for the intended use. All such  
compositions may be prepared in any manner known to  
the art.

Compositions suitable for administration to  
vertebrates or man include preparations suitable for  
oral, parenteral, percutaneous, e.g. pour-on, or  
topical administration.

Compositions for oral administration comprise one or more of the compounds of general formula I in association with pharmaceutically acceptable carriers or coatings and include, for example, tablets, pills, capsules, pastes, gels, drenches, medicated feeds, medicated drinking water, medicated dietary supplements, slow-release boluses or other slow-release devices intended to be retained within the gastro-intestinal tract. Any of these may incorporate active ingredient contained within microcapsules or coated with acid-labile or alkali-labile or other pharmaceutically acceptable enteric coatings. Feed premixes and concentrates containing compounds of the present invention for use in preparation of medicated diets, drinking water or other materials for consumption by animals may also be used.

Compositions for parenteral administration include solutions, emulsions or suspensions in any suitable pharmaceutically acceptable vehicle and solid or semisolid subcutaneous implants or pellets designed to release active ingredient over a protracted period and may be prepared and made sterile in any appropriate manner known to the art.

Compositions for percutaneous and topical administration include sprays, dusts, baths, dips, showers, jets, greases, shampoos, creams, wax-smeats, or pour-on preparations and devices (e.g. ear tags) attached externally to animals in such a way as to provide local or systemic arthropod control.

Solid or liquid baits suitable for controlling arthropods comprise one or more compounds of general formula I and a carrier or diluent which may include a food substance or some other substance to induce consumption by the arthropod.

Liquid compositions include water miscible concentrates, emulsifiable concentrates, flowable suspensions, wettable or soluble powders containing one or more compounds of general formula I which may be used to treat substrates or sites infested or liable to infestation by arthropods including premises, outdoor or indoor storage or processing areas, containers or equipment and standing or running water.

Solid homogenous or heterogenous compositions containing one or more compounds of general formula I, for example granules, pellets, briquettes or capsules, may be used to treat standing or running water over a period of time. A similar effect may be achieved using trickle or intermittent feeds of water dispersible concentrates as described herein.

Compositions in the form of aerosols and aqueous or non-aqueous solutions or dispersions suitable for spraying, fogging and low- or ultra-low volume spraying may also be used.

5            Suitable solid diluents which may be used in the preparation of compositions suitable for applying the compounds of general formula I include aluminium silicate, kieselguhr, corn husks, tricalcium phosphate, powdered cork, adsorbent carbon black,  
10           magnesium silicate, a clay such as kaolin, bentonite or attapulgite, and water soluble polymers and such solid compositions may, if desired, contain one or more compatible wetting, dispersing, emulsifying or colouring agents which, when solid, may also serve as  
15           diluent.

            Such solid compositions, which may take the form of dusts, granules or wettable powders, are generally prepared by impregnating the solid diluents with solutions of the compound of general formula I in  
20           volatile solvents, evaporating the solvents and, if necessary, grinding the products so as to obtain powders and, if desired, granulating or compacting the products so as to obtain granules, pellets or briquettes or by encapsulating finely divided active  
25           ingredient in natural or synthetic polymers, e.g. gelatin, synthetic resins and polyamides.

The wetting, dispersing and emulsifying agents which may be present, particularly in wettable powders, may be of the ionic or non-ionic types, for example sulphoricinoleates, quaternary ammonium derivatives or products based upon condensates of ethylene oxide with nonyl- and octyl-phenol, or carboxylic acid esters of anhydrosorbitols which have been rendered soluble by etherification of the free hydroxy groups by condensation with ethylene oxide, or mixtures of these types of agents. Wettable powders may be treated with water immediately before use to give suspensions ready for application.

Liquid compositions for the application of the compounds of general formula I may take the form of solutions, suspensions and emulsions of the compounds of general formula I optionally encapsulated in natural or synthetic polymers, and may, if desired, incorporate wetting, dispersing or emulsifying agents. These emulsions, suspensions and solutions may be prepared using aqueous, organic or aqueous-organic diluents, for example acetophenone, isophorone, toluene, xylene, mineral, animal or vegetable oils, and water soluble polymers (and mixtures of these diluents), which may contain wetting, dispersing or emulsifying agents of the ionic or non-ionic types or mixtures thereof, for example

those of the types described above. When desired,  
the emulsions containing the compounds of general  
formula I may be used in the form of self-emulsifying  
concentrates containing the active substance dissolved  
5 in the emulsifying agents or in solvents containing  
emulsifying agents compatible with the active  
substance, the simple addition of water to such  
concentrates producing compositions ready-for use.-----

Compositions containing compounds of general  
10 formula I which may be applied to control arthropod,  
plant nematode or helminth pests, may also contain  
synergists (e.g. piperonyl butoxide or sesamex),  
stabilizing substances, other insecticides,  
acaricides, plant nematocides or anthelmintics,  
15 fungicides (agricultural or veterinary as appropriate  
e.g. benomyl, iprodione), bactericides, arthropod or  
vertebrate attractants or repellants or pheromones,  
reodorants, flavouring agents, dyes and auxiliary  
therapeutic agents, e.g. trace elements. These may  
20 be designed to improve potency, persistence, safety,  
uptake where desired, spectrum of pests controlled or  
to enable the composition to perform other useful  
functions in the same animal or area treated.



Examples of other pesticidally-active compounds which may be included in, or used in conjunction with, the compositions of the present invention are:-

5 acephate, chlorpyrifos, demeton-S-methyl, disulfoton, ethoprophos, fenitrothion, malathion, monocrotophos, parathion, phosalone, pirimiphos-methyl, triazophos, cyfluthrin, cypermethrin, deltamethrin, fenpropathrin, fenvalerate, permethrin, aldicarb, carbosulfan, methomyl, oxamyl, pirimicarb, bendiocarb,  
10 teflubenzuron, dicofol, endosulfan, lindane, benzoximate, cartap, cyhexatin, tetradifon, avermectins, ivermectin, milbemycins, thiophanate, trichlorfon and dichlorvos.

15 The compositions for application to control arthropods usually contain from 0.00001% to 95%, more particularly from 0.0005% to 50%, by weight of one or more compounds of general formula I or of total active ingredients (that is to say the compound(s) of general formula I together with other substances toxic to  
20 arthropods and plant nematodes, anthelmintics, synergists, trace elements or stabilisers). The actual compositions employed and their rate of application will be selected to achieve the desired effects(s) by the farmer, livestock producer, medical  
25 or veterinary practitioner, pest control operator or

other person skilled in the art. Solid and liquid compositions for application topically to animals, timber, stored products or household goods usually contain from 0.00005% to 90%, more particularly from 0.001% to 10%, by weight of one or more compounds of general formula I. For administration to animals orally or parenterally,—including percutaneously, solid and liquid compositions normally contain from 0.1% to 90% by weight of one or more compounds of general formula I. Medicated feedstuffs normally contain from 0.001% to 3% by weight of one or more compounds of general formula I. Concentrates and supplements for mixing with feedstuffs normally contain from 5% to 90%, and preferably from 5% to 50%, by weight of one or more compounds of general formula I. Mineral salt licks normally contain from 0.1% to 10% by weight of one or more compounds of general formula I.

Dusts and liquid compositions for application to livestock, persons, goods, premises or outdoor areas may contain 0.0001% to 15%, and more especially 0.005% to 2.0%, by weight of one or more compounds of general formula I. Suitable concentrations in treated waters are between 0.0001 ppm and 20 ppm, and more especially 0.001 ppm to 5.0 ppm, of one or more compounds of general formula I and may also be used therapeutically in fish farming with appropriate exposure times.

Edible baits may contain from 0.01% to 5% and preferably 0.01% to 1.0%, by weight of one or more compounds of general formula I.

When administered to vertebrates parenterally,  
5 orally or by percutaneous or other means, the dosage of compounds of general formula I will depend upon the species, age and health of the vertebrate and upon the nature and degree of its actual or potential  
10 infestation by arthropods. A single dose of 0.1 to 100 mg, preferably 2.0 to 20.0 mg, per kg body weight of the animal or doses of 0.01 to 20.0 mg, preferably 0.1 to 5.0 mg, per kg body weight of the animal per day for sustained medication are generally suitable by oral or parenteral administration. By use of  
15 sustained release formulations or devices, the daily doses required over a period of months may be combined and administered to animals on a single occasion.

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The present invention accordingly provides an arthropodical, plant nematocidal or anthelmintic composition which comprises at least one compound of general formula I, or a salt thereof, in association with one or more compatible diluents or carriers with the provisos that (1) when the composition comprises a single compound of general formula I wherein  $R^4$  and  $Z$  both represent methyl, Y represents thiocyanato and  $(R^3)_n$  represents 2-, 3- or 4-nitro, 4-methyl, 4-chloro or 2,4-dinitro substitution; or  $R^4$  represents methyl, Y represents cyano, Z represents unsubstituted amino and  $(R^3)_n$  represents 4-chloro, 2,4-dichloro, 3,4-dichloro, 3-chloro-4-methyl or 2-methyl-4-chloro substitution, the composition is not an association of a single compound of general formula I alone with water or a common organic solvent; (2) when the composition comprises a single compound of general formula I wherein  $R^4$  represents methyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3- or 4-fluoro substitution; or  $R^4$  represents ethyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3- or 4-chloro, 2-, 3- or 4-fluoro or methyl, 3-bromo or 3-nitro substitution; or  $R^4$  represents propyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3-fluoro

substitution; or  $R^4$  represents methyl, Y represents  
sulphamoyl, Z represents chloro and  $(R^3)_n$

represents 4-chloro substitution; the composition  
comprises an agriculturally acceptable surface active  
agent or a feedstuff; (3) when  $R^4$  represents

methyl, Y represents nitro, and Z represents chloro or  
 $R^4$  represents chloro, Y represents nitro, and Z  
represents methyl and  $(R^3)_n$  represents 4-nitro,

the composition comprises a pharmaceutically

acceptable adjuvant or a feedstuff or is substantially  
sterile and pyrogen-free or is in unit dosage form;

and (4) excluding compositions comprising

1-(4-nitrophenyl)-3-nitro-4-pyrazole-carbonitrile or  
carboxamide.

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Medicated feeds which comprise known compounds of general formula I and arthropodically- or anthelmintically-acceptable salts thereof and an edible carrier or diluent form a feature of the present invention.

In experiments on activity against arthropods carried out on representative compounds, the following results (wherein 'Dose mg/kg' indicates the dose of test compound administered in mg per kg animal body weight and ppm indicates the concentration of the compound in parts per million of the test solution applied) have been obtained:-

Test 1

One or more dilutions of the compounds to be tested were made in 50% aqueous acetone.

5 a) Test species: Plutella xylostella (Diamond-back Moth) and Phaedon cochleariae (Mustard Beetle).

10 Turnip leaf discs were set in agar in petri-dishes and infected with 10 larvae (2nd instar Plutella or 3rd instar Phaedon). Four replicate dishes were assigned to each treatment and were sprayed under a Potter Tower with the appropriate test dilution. Four or five days after treatment the dishes were removed from the constant temperature (25°C) room in which they had been held and the mean percentage mortalities of larvae were determined. These data were corrected against the mortalities in dishes treated with 50% aqueous acetone alone which served as controls .

15 b) Mezoura viciae (Vetch Aphid)

20 Potted tic bean plants previously infected with mixed stages of Mezoura were sprayed to run-off using a laboratory turntable sprayer. Treated plants were held in a greenhouse for 2 days and were assessed for aphid mortality using a scoring system, judging the response in comparison with plants treated with 50% aqueous acetone alone, as controls .

25

Score

	3	all aphids dead
	2	few aphids alive
	1	most aphids alive .
5	0	no significant mortality

According to the above method (a) an application of 500 ppm of the following compounds was totally effective against the larvae of Plutella xylostella, producing 100% mortality.

10 Compound No.

5, 6, 7, 8, 20, 21, 22, 28, 30, 31, 32, 35, 36, 37, 38, 39, 41, 42, 43, 44, 68, 69, 70, 71, 72, 73, 76, 79, 80, 81, 85, 87, 94, 99, 102, 103, 104, 105, 106, 108, 111, 120, 121

15 According to the above method (a) an application of 5 ppm of the following compounds was totally effective against the larvae of Phaedon cochleariae, producing 100% mortality.

Compound No.

20 36, 53, 57, 58, 70, 71, 74, 79, 80, 85, 90, 91, 97, 98, 99, 102, 104, 106, 108, 109, 111, 112, 113, 116, 118, 120, 121



According to the above method (b) an application of 50 ppm of the following compounds was totally effective against Megoura viciae producing 100% mortality, that is giving a score of 12 from 4 replicates.

Compound No

4, 5, 20, 21, 36, 48, 53, 57, 58, 82, 83, 92, 93, 98, 102, 106, 109, 111, 116, 117, 118, 120

The data quoted in Tables 1-3 summarise the results from a number of different experiments carried out to the protocols a) and b) above.

Table 1

<u>No.</u>	Plutella		Phaedon		Megoura	
	Zm	500 ppm	Zm	10 ppm	score/12	50 ppm
5				100		
6				100	9	
7				100	10	
19		100*		100	10	
20				100		
21				100		
42				100	10	
10		73		45	10	
43				100	11	

Table 2

	<u>No.</u>	Plutella		Phaedon	
		$\lambda_m$	500 ppm	$\lambda_m$	10 ppm
	8				93
5	2		89		100
	47		96		100
	35				100
	22				100
	23		58		100
ed 10	24		10		100
	30				100
	28				56
	29		48		100
	25		21*		100
15	31				16
	38				85
	41				100
	37				100
	33		44		100
20	44				100
	32				84
	40		98		21
	39				100

25

Table 3

	No.	Phaedon	Megoura
		10 ppm	score/12 50 ppm
	4	98	
5	45	100	11
	9	68	10+

\* % mortality at 100 ppm

+ score at 10 ppm

10

### Test 2

Some 20 larvae of Rhipicephalus appendiculatus were placed in plastic capsules attached to the shaved flank of guinea-pigs. After 3 hours and then at 23 hourly intervals, the guinea-pigs were given a total of 4 subcutaneous injections of the test compound. .

Approximately 100 hours after infestation, the guinea-pigs were killed and the engorged tick larvae recovered, counted and kept at 23°C in a humidity cabinet for 14 to 21 days. After this period, the percentage survival through moulting was assessed.

Results obtained are given below in Table 4.

25

Table 4

	Compound No.	Dose (mg/kg at each repetition)	Result
5	12	5	No ticks recovered
		4	No ticks recovered
		3	Less than five engorged ticks recovered
		2.5	Ticks engorged normally but only 62.5 per cent survived
10	5	5	No ticks recovered
		4	No ticks recovered
		3	Number of engorged ticks reduced, only 8.3 per cent survived
		2.5	Ticks engorged normally but only 30.0 per cent survived
		1.0	Ticks engorged normally but only 47.9 per cent survived
15	26	10	No ticks recovered
		5	Less than five engorged ticks recovered
	25	15	No ticks recovered
5		No ticks recovered	
2.5		No ticks recovered	

Test 3

The high activity of the compounds of general formula against the cockroach species Periplaneta americana is demonstrated by results from the following experiment.

0.2 microlitres of an acetone solution of the compound was injected through the soft cuticle between the leg and thorax of ten insects, to give a dose rate of 5 micrograms per g of insect body weight. Ten cockroaches were similarly injected with 0.2 microlitres of acetone alone to serve as controls. After treatment the insects were held in plastic boxes with appropriate food. Five days after treatment the numbers of dead and alive insects were counted and percentage mortalities calculated.

According to the above method a dose of 5 micrograms/g insect body weight of the following compounds was totally effective against the cockroach species Periplaneta americana producing 100% mortality.

Compound No.

2, 5, 14, 17, 22, 53

The following Examples illustrate compositions for use against arthropod, plant nematode or helminth pests which comprise, as active ingredient, compounds of general formula I.

Example A

A dusting powder may be prepared by intimately mixing:-

5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)- ..... 1 to 10% w/w  
3-trifluoromethylpyrazole (weight/weight)  
Talc superfine ..... to 100% by weight

This powder may be applied to a locus of arthropod infestation, for example refuse tips or dumps, stored products or household goods or animals infested by, or at risk of infestation by, arthropods to control the arthropods by oral ingestion. Suitable means for distributing the dusting powder to the locus of arthropod infestation include mechanical blowers, handshakers and livestock self treatment devices.

The 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole may, if desired, be replaced in the above dusting powder by any other compound of general formula I.

Example B

An edible bait may be prepared by intimately mixing:-

5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)- ..... 0.1 to 1.0% w/w  
3-trifluoromethylpyrazole  
Wheat flour ..... 80% w/w  
Molasses ..... to 100% w/w

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This edible bait may be distributed at a locus, for example domestic and industrial premises, e.g. kitchens, hospitals or stores, or outdoor areas, infested by arthropods, for example ants, locusts, cockroaches and flies, to control the arthropods by oral ingestion.

The 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole may, if desired, be replaced in the above edible bait by any other compound of general formula I.

Example C

A solution may be prepared containing:-

5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-	..... 15% w/v
3-trifluoromethylpyrazole	(weight/volume)

Dimethylsulphoxide ..... to 100% by volume

by dissolving the pyrazole derivative in a portion of the dimethylsulphoxide and then adding more dimethylsulphoxide to the desired volume. This solution may be applied to domestic animals infested by arthropods, percutaneously as a pour-on application or, after sterilisation by filtration through a polytetrafluoroethylene membrane (0.22  $\mu$ m pore size), by parenteral injection, at a rate of application of from 1.2 to 12 ml of solution per 100 kg of animal body weight.

The 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole may, if desired, be replaced in the above solution by similar amounts of any other compound of general formula I.

5

Example D

A wettable powder may be formed from:-

5-amino-4-cyano-1-(2,6-dichloro-4-  
trifluoromethylphenyl)- ..... 50% w/w  
3-trifluoromethylpyrazole  
10 Ethylan BCP (a nonylphenol/ethylene oxide  
condensate containing 9 moles of  
ethylene oxide per mol of phenol) ..... 5% w/w  
Aerosil (silicon dioxide of microfine-  
particle size) ..... 5% w/w  
15 Celite PF (synthetic magnesium  
silicate carrier) ..... 40% w/w

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by adsorbing the Ethylan BCP onto the Aerosil, mixing with the other ingredients and grinding the mixture in a hammer-mill to give a wettable powder, which may be diluted with water to a concentration of from 0.001% to 2% w/v of the pyrazole compound and applied to a locus of infestation by arthropods, for example dipterous larvae, or plant nematodes by spraying, or to domestic animals infested by, or at risk of infestation by, arthropods, by spraying or dipping, or by oral administration as drinking water, to control the arthropods or helminths.



The 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole may, if desired, be replaced in the above wettable powder by any other compound of general formula I.

5

Example E

A slow release bolus may be formed from granules containing a density agent, binder, slow-release agent and 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole compound at varying percentage compositions. By compressing the mixture a bolus with a specific gravity of 2 or more can be formed and may be administered orally to ruminant domestic animals for retention within the reticulo-rumen to give a continual slow release of pyrazole compound over an extended period of time to control infestation of the ruminant domestic animals by arthropods or helminths.

10  
15

The 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole may, if desired, be replaced in the above bolus by any other compound of general formula I.

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Example F

A slow release composition may be prepared from:-  
5-amino-4-cyano-1-(2,6-dichloro-4-

trifluoromethylphenyl)- ..... 0.5 to 25% w/w

5 3-trifluoromethylpyrazole

polyvinylchloride base ..... to 100% w/w

by blending the polyvinylchloride base with the

pyrazole compound and a suitable plasticiser, e.g.

dioctyl phthalate, and melt-extruding or hot-moulding

10 the homogenous composition into suitable shapes, e.g.

granules, pellets, brickettes or strips, suitable, for

example, for addition to standing water or, in the

case of strips, fabrication into collars or ear-tags

for attachment to domestic animals, to control insect

15 pests by slow release of the pyrazole compound.

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13

The compounds of general formula I can be prepared by the application or adaptation of known methods (i.e. methods heretofore used or described in the chemical literature), generally heterocycle formation followed where necessary by changing substituents with protection/deprotection of other substituents if necessary, for example as hereinafter described.

In the following description when symbols appearing in formulae are not specifically defined it is to be understood that they are "as hereinbefore defined" in accordance with the first definition of each symbol in this specification.

Compounds of general formula I conforming to general formula IA wherein Y' represents the cyano or nitro group or a group  $\text{RSO}_2$ ,  $\text{RSO}$  or  $\text{RS}$ , a straight- or branched-chain alkoxycarbonyl group containing from 2 to 7 carbon atoms, or a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms, Z' represents the unsubstituted amino group or a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms, and  $\text{R}^5$  represents a fluorine, chlorine or bromine atom, the cyano group or a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms which may be unsubstituted or substituted by one or more halogen

atoms, or a cycloalkyl group containing from 3 to 6 carbon atoms, may be prepared by the process which comprises

(i) the reaction of a compound of the general formula II, or an acid addition salt thereof, e.g. the hydrochloride, with (1), when  $R^5$  in the compound of general formula IA represents a fluorine, chlorine or bromine atom, an optionally halogenated straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms or a cycloalkyl group containing from 3 to 6 carbon atoms, a compound of the general formula III, wherein  $R^6$  represents the cyano group or a straight- or branched-chain alkanoyl group containing from 2 to 5 carbon atoms and  $R^8$  represents a straight- or branched-chain alkoxy group containing from 1 to 4 carbon atoms, preferably ethoxy, the hydroxy group or a fluorine, chlorine or bromine atom, or (2), when  $R^5$  in the compound of general formula IA represents the cyano group (and  $Y'$  represents the cyano group and  $Z'$  represents the unsubstituted amino group), tetracyanoethylene.

The reaction of a compound of general formula II with a compound of general formula III (optionally prepared in situ) or tetracyanoethylene may be effected in the presence of an inert organic solvent, for example an alkanol containing from 1 to 4 carbon atoms, e.g. ethanol, acetic acid, ethoxyethanol or an ether, and at a temperature from ambient temperature to the reflux temperature of the reaction mixture and optionally in the presence of an alkali metal, e.g. sodium or potassium, acetate, carbonate or bicarbonate or organic base e.g. triethylamine. When an acid addition salt of the compound of general formula II is used, the reaction with the compound of general formula III is effected in the presence of an alkali metal, e.g. sodium or potassium, acetate, carbonate or bicarbonate.

(ii) Compounds of general formula IA wherein Z' represents the unsubstituted amino group may alternatively be prepared directly by reacting a compound of general formula  $Y'CH_2CN$  with a compound of general formula II in the presence of a compound of general formula  $R^7C(R^O)_3$  wherein  $R^7$  represents a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms or a cycloalkyl group containing from 3 to 6 carbon atoms and  $R^O$  represents an alkoxy group which may be

straight- or branched-chain and preferably contains from 1 to 4 carbon atoms, in an inert organic solvent, preferably ethanol, at a temperature from ambient to reflux.

- 5 (iii) Compounds of general formula IA wherein Z' represents the unsubstituted amino group and R<sup>5</sup> represents the cyano group may be obtained by the reaction of a compound of the general formula IV with a molar equivalent of compound of general formula
- 10 Y'CH<sub>2</sub>CN, i.e. malononitrile when Y' represents the cyano group, generally in the presence of an anhydrous inert organic solvent, e.g. ethanol, and a molar equivalent of a base, e.g. sodium hydride, and at a temperature from 0 to 50°C.

- 15 The compounds of general formula IA may be prepared by reaction of a compound of general formula II with a compound of general formula III or tetracyanoethylene with isolation of an intermediate compound of general formula V from the reaction
- 20 mixture. When the reaction of a compound of general formula II with a compound of general formula III is effected in acetic acid, in the absence or presence of an alkali metal, e.g. sodium or potassium, acetate, the intermediate compound of general formula V may
- 25 separate from the reaction mixture, depending upon its solubility in the reaction medium, and may, if desired, be isolated before being cyclised as

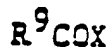
hereinbefore described to a compound of general formula IA. The cyclisation of a compound of general formula V, which constitutes a feature of the invention may be effected in the presence of an inert organic solvent, for example an alkanol containing from 1 to 4 carbon atoms, e.g. ethanol, acetic acid or ethoxyethanol, at a temperature of from ambient temperature up to the reflux temperature of the reaction mixture, and optionally in the presence of sodium ethoxide when the solvent is ethanol.

It will be appreciated that in the preparation of compounds of general formula I the following subsidiary processes or adaptations thereof may be performed in an appropriate combination to achieve the compound sought.

Compounds of general formula I which conform to general formula IB wherein  $R^1$  represents an  $R^9C(=O)-$  group, wherein  $R^9$  represents a straight- or branched-chain alkyl or alkoxy group containing from 1 to 6 carbon atoms, or a cycloalkyl group containing from 3 to 6 carbon atoms and  $R^2$  represents a hydrogen atom or an  $R^9C(=O)-$  group which is identical to the group  $R^9C(=O)-$  represented by  $R^1$  or  $-NR^1R^2$  represents a cyclic imide as hereinbefore defined, may be prepared by the reaction

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of a compound of general formula I wherein Z represents the unsubstituted amino group, or an alkali metal salt thereof, with a compound of the general formula:-



VI

wherein X represents a chlorine or bromine atom, or with a compound of the general formula:-



VII

or with a dicarboxylic acid derivative. The reaction may be conducted in the absence or presence of an inert organic solvent, for example acetonitrile, tetrahydrofuran, a ketone, e.g. acetone, an aromatic hydrocarbon, e.g. benzene or toluene, chloroform, dichloromethane or dimethylformamide, and optionally in the presence of an acid-binding agent, for example pyridine, triethylamine or an alkali metal, e.g. sodium or potassium, carbonate or bicarbonate, at a temperature from 0°C to the reflux temperature of the reaction medium, to give a compound of general formula IB wherein  $R^1$  represents an  $R^9C(=O)-$  group wherein  $R^9$  is as hereinbefore defined and  $R^2$  represents a hydrogen atom or an  $R^9C(=O)-$  group, depending upon the reaction conditions chosen and/or the use of an excess of the compound of general formula VI or VII.



Compounds of general formula IB wherein  $R^1$  represents a formyl group and  $R^2$  represents a hydrogen atom may be prepared by reaction of a compound of general formula I, wherein Z represents the unsubstituted amino group with formic acid. The reaction may be conducted in an inert organic solvent, for example a ketone e.g. methylisobutyl ketone, or an aromatic hydrocarbon, e.g. benzene or toluene, at the reflux temperature of the reaction mixture.

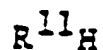
Compounds of general formula IB wherein  $R^1$  represents a formyl group and  $R^2$  represents a hydrogen atom or a formyl group, may be prepared by the reaction of a compound of general formula I, wherein Z represents the unsubstituted amino group with formylacetic anhydride. Formylacetic anhydride may be prepared from formic acid and acetic anhydride and the reaction with the compound of general formula I may be conducted in the absence or presence of an inert organic solvent, for example a ketone, e.g. acetone, or an aromatic hydrocarbon, e.g. benzene or toluene, and optionally in the presence of an acid-binding agent, for example pyridine, triethylamine or an alkali metal, e.g. sodium or potassium, carbonate or bicarbonate, at a temperature from 0°C to the reflux temperature of the reaction mixture, to give a compound of general formula IB

wherein  $R^1$  represents a formyl group and  $R^2$  represents a hydrogen atom or a formyl group, depending upon the reaction conditions chosen and/or the use of an excess of formylacetic anhydride.

5 Compounds of general formula IB wherein  $R^1$  represents a formyl group or a group  $R^9C(=O)-$  and  $R^2$  represents a hydrogen atom may be prepared by the selective removal by hydrolysis of an  $R^9C(=O)-$  group or a formyl group from a compound of general formula  
10, IB wherein  $R^1$  and  $R^2$  both represent a  $R^9C(=O)$  group or a formyl group. Hydrolysis is effected under mild conditions, for example by treatment with an aqueous-ethanolic solution or suspension of an alkali metal, e.g. sodium or potassium, bicarbonate,  
15 or with aqueous ammonia.

Compounds of general formula IB wherein  $R^1$  represents a straight- or branched-chain  
alkoxycarbonyl group containing from 2 to 7 carbon  
atoms which is unsubstituted or substituted by one  
20 or more halogen atoms, and  $R^2$  represents a hydrogen atom may be prepared by the reaction of a compound of the general formula VIII, wherein  $R^{10}$  represents an  
alkoxycarbonyl group  $R^{11}C(=O)$ , wherein  $R^{11}$   
represents a straight- or branched-chain alkoxy group  
25 containing from 1 to 6 carbon atoms (which is unsubstituted or substituted by one or more halogen atoms) or a phenoxy group, with a compound of the

general formula:-



IX

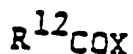
5 to replace a first group represented by the symbol  $R^{10}$  by a hydrogen atom, and to replace the second group represented by the symbol  $R^{10}$  by an alkoxycarbonyl group when  $R^{10}$  represents a phenoxy carbonyl group, or, if desired, to replace the second group represented by the symbol  $R^{10}$  by another alkoxycarbonyl group when  $R^{10}$  in formula VIII represents an alkoxycarbonyl group. As will be apparent to those skilled in the art, the desired compound of general formula IB is obtained by selection of the appropriate compounds of general formulae VIII and IX. The reaction may be effected in water or an inert aqueous-organic or organic solvent, for example an alkanol containing 1 to 4 carbon atoms, e.g. ethanol, or an aromatic hydrocarbon, e.g. benzene or toluene, or which is preferably an excess of the compound of general formula IX, at a temperature from ambient temperature to the reflux temperature of the reaction mixture and, if necessary, at elevated pressure, and optionally in the presence of a base, for example an alkali metal alkoxide, e.g. of the compound of general formula IX.

Compounds of general formula IB wherein  $R^1$  and  $R^2$ , which may be the same or different, each represents a formyl group or a  $R^9C(=O)-$  group, may be prepared by the reaction of an alkali metal, e.g. sodium or potassium, derivative of a compound of general formula IB wherein  $R^1$  represents a group  $R^9C(=O)-$  as hereinbefore defined, or a formyl group, and  $R^2$  represents a hydrogen atom with formic acid, formylacetic anhydride or a compound of general formula VI. Reaction may be effected in an inert aprotic solvent, e.g. dimethylformamide, at a temperature from laboratory temperature to the reflux temperature of the reaction mixture.

Alkali metal derivatives of compounds of general formula I (wherein Z represents the unsubstituted amino group) or IB wherein  $R^1$  represents a group  $R^9C(=O)-$  and  $R^2$  represents a hydrogen atom may be prepared in situ by reaction with an alkali metal, e.g. sodium or potassium, hydride, in an inert aprotic solvent, e.g. dimethylformamide, at a temperature from laboratory temperature to the reflux temperature of the reaction mixture.

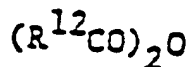
Compounds of general formula VIII wherein  $R^{10}$  represents a group  $R^{11}C(=O)-$ , may be prepared as hereinbefore described. Compounds of general formula VIII wherein  $R^{10}$  represents a phenoxycarbonyl group may be prepared by the reaction of a compound of

general formula I (wherein Z represents the unsubstituted amino group), with a compound of the general formula:-



VIA

, wherein  $R^{12}$  represents a phenoxy group, or with a compound of the general formula:-



VIIA

using the reaction conditions hereinbefore described for the reaction of a compound of general formula I with a compound of formula VI or VII.

Compounds of general formula IB wherein  $R^1$  represents a group  $R^{13}$  which represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms (which may be unsubstituted or substituted by alkoxycarbonyl groups containing from 2 to 5 carbon atoms) or a cycloalkyl group containing from 3 to 6 carbon atoms, and  $R^2$  represents a hydrogen atom may be prepared by the removal of the group  $R^9C(=O)-$  of a compound of the general formula IB, wherein  $R^1$  represents a group  $R^{13}$  and  $R^2$  represents a group  $R^9C(=O)-$ . Removal of the group  $R^9C(=O)-$  may be effected by selective hydrolysis under mild conditions, for example by treatment with an alkali metal, e.g. sodium or potassium, hydroxide in water or an inert organic or aqueous-organic solvent, for example a lower alkanol, e.g. methanol, or a mixture of water and lower alkanol, at a

temperature from laboratory temperature up to the reflux temperature of the reaction mixture.

Compounds of general formula IB, wherein  $R^1$  represents a group  $R^{13}$  and  $R^2$  represents a group  $R^9C(=O)-$ , may be prepared by reaction of a compound of general formula IB wherein  $R^1$  represents a hydrogen atom, or an alkali metal, e.g., sodium or potassium, derivative thereof, with a compound of the general formula:-



, wherein  $X^1$  represents a chlorine, bromine or iodine atom. Reaction may be effected in an inert organic solvent, e.g. dichloromethane, tetrahydrofuran, or dimethylformamide, at a temperature from laboratory temperature up to the reflux temperature of the reaction mixture and, when a compound of general formula IB is used, in the presence of a base, e.g. Triton B; or by reaction of a compound of general formula IB wherein  $R^1$  represents the hydrogen atom and  $R^2$  represents a group  $R^{13}$  with a compound of general formula VI or VII.

Compounds of general formula I wherein Z represents an N-(alkyl or cycloalkyl)-N-formylamino group as hereinbefore described may be prepared in a similar manner to the process above using, where appropriate, formylacetic anhydride instead of a compound of general formula VI or VII.

Compounds of general formula IB wherein one of  $R^1$  and  $R^2$  or both of  $R^1$  and  $R^2$  represent a straight- or branched- chain alkyl group containing from 1 to 6 carbon atoms or cycloalkyl group containing from 3 to 6 carbon atoms, groups represented by  $R^1$  and  $R^2$  being identical, may be prepared by reaction of a compound of general formula I, wherein Z represents the unsubstituted amino group, or an alkali metal, e.g. sodium or potassium, derivative thereof, with a compound of general formula X, in the absence or presence of an inert organic solvent, for example an aromatic hydrocarbon, e.g. benzene or toluene, chloroform, dichloromethane, tetrahydrofuran or dimethylformamide, and optionally in the presence of an acid-binding agent, for example pyridine, triethylamine or an alkali metal, e.g. sodium or potassium, bicarbonate, at a temperature from 0°C up to the reflux temperature of the reaction mixture.

Alkali metal derivatives of compounds of formulae IB (wherein  $R^1$  represents a hydrogen atom) and I (wherein Z represents the unsubstituted amino group) may be prepared in situ by the reaction of the compounds, with an alkali metal, e.g. sodium or potassium, hydride, at a temperature from laboratory temperature to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Z represents a straight- or branched-chain alkoxymethyleneamino group containing from 2 to 5 carbon atoms which may be unsubstituted or substituted on methylene by a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms may be prepared by the reaction of a compound of general formula I (wherein Z represents the unsubstituted amino group) with a trisalkoxyalkane in the presence of an acidic catalyst, e.g. p-toluenesulphonic acid, at a temperature from ambient temperature to the reflux temperature of the reaction mixture.

Compounds of general formula I, wherein Z represents a straight- or branched-chain alkylsulphenylamino group containing from 1 to 4 carbon atoms, may be prepared by the reaction of compounds of general formula I (wherein Z represents the unsubstituted amino group) with an alkanesulphenyl chloride in the presence of a base, e.g. sodium hydride, and optionally in the presence of a crown ether catalyst, e.g. 15-crown-5.

The reaction may be performed in a solvent, e.g. tetrahydrofuran, at a temperature from 0°C to the reflux temperature of the reaction mixture.



Compounds of general formula I wherein Z represents  $\text{-NHCH}_2\text{R}^{14}$  wherein  $\text{R}^{14}$  represents the hydrogen atom or a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms may be prepared by reaction of a compound of general formula I wherein Z represents  $\text{-N=C(OR}^{15})\text{R}^{14}$  wherein  $\text{R}^{15}$  represents a straight- or branched-chain alkyl-group containing from 1 to 4 carbon atoms with a reducing agent, preferably sodium borohydride. The reaction may be effected in an inert organic solvent, ethanol or methanol being preferred, at a temperature from  $0^\circ\text{C}$  to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Y represents  $\text{-C(=O)NH}_2$  may be prepared by partial hydrolysis of a compound of general formula I wherein Y represents  $\text{-CN}$  preferably with sulphuric acid at a temperature from ambient temperature to  $100^\circ\text{C}$ .

Compounds of general formula I wherein Y represents the chlorine, bromine or iodine atom may be prepared by reaction of a compound of general formula XI with a halogenating agent, preferably N-halosuccinimide in an inert solvent, preferably carbon tetrachloride, at a temperature from ambient temperature to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Z represents the chlorine, bromine or iodine atom may be prepared by diazotisation of a compound of general formula I wherein Z represents  $\text{-NH}_2$  with an alkyl nitrite, preferably tert-butyl nitrite, in the presence of a halogenating agent preferably bromoform, iodine or anhydrous copper chloride at a temperature from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ .

Compounds of general formula I wherein Y represents the nitro group may be prepared by reacting a compound of general formula XI with a nitrating agent, preferably nitric acid optionally in the presence of sulphuric acid or nitric acid in a solvent such as acetic acid or acetic anhydride at a temperature from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ .

Compounds of general formula I wherein Y represents  $\text{-SO}_2\text{NR}^{16}\text{R}^{17}$  wherein  $\text{R}^{16}$  and  $\text{R}^{17}$ , which may be the same or different, each represent the hydrogen atom or a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms may be prepared by reacting a compound of general formula XIV with an amine of the general formula  $\text{R}^{16}\text{R}^{17}\text{NH}$  in a solvent such as toluene or water at a temperature from  $0^\circ\text{C}$  to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Y represents  $\text{-CONR}^{16}\text{R}^{17}$  may be prepared by reacting a compound of general formula XV wherein  $\text{X}^2$  represents a chlorine or bromine atom or activated ester moiety e.g. 4-nitrophenoxy group, especially the chlorine atom, with an amine of the general formula  $\text{R}^{16}\text{R}^{17}\text{NH}$ , in a solvent such as toluene or water, at a temperature from  $0^\circ\text{C}$  to the reflux temperature of the reaction mixture.

Intermediates of general formula XI may be prepared by decarboxylation of a compound of general formula XVI, performed by heating at a temperature from  $100^\circ\text{C}$  to  $250^\circ\text{C}$  optionally in the presence of an inert organic solvent, particularly N,N-dimethylaniline.

Intermediates of general formula XI wherein Z is the unsubstituted amino group and  $\text{R}^4$  represents a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms may also be prepared by reaction of an appropriate  $\beta$ -ketonitrile or derivative thereof e.g. the imine with an arylhydrazine in an inert organic solvent such as ethanol optionally in the presence of an acidic or basic catalyst at a temperature from ambient to  $100^\circ\text{C}$ .

Alternatively intermediates of general formula XI may be prepared directly from esters of compounds of general formula XVI by heating in an inert organic solvent preferably acetic acid at a temperature from 50°C to reflux, in the presence of a strong acid preferably hydrobromic acid.

Intermediates of general formula XVI may be prepared by hydrolysis of esters of general formula I wherein Y represents  $-COOR^{18}$  wherein  $R^{18}$  represents a straight- or branched- chain alkyl group containing from 1 to 6 carbon atoms, preferably with an alkali metal hydroxide in a solvent such as an aqueous alcohol at a temperature from 0°C to the reflux temperature of the reaction mixture.

Intermediates of general formula XIV may be prepared by reacting a compound of general formula XI with chlorosulphonic acid at a temperature from 0°C to 150°C.

Intermediates of general formula XV are prepared by reacting a compound of general formula XVI with a chlorinating or brominating agent or e.g. 4-nitrophenol (preferably thionyl chloride) at a temperature from ambient temperature to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Y represents  $-C(=O)R^{18}$  wherein  $R^{18}$  represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms may be prepared by the reaction of a compound of general formula XI with an acylating agent such as  $R^{18}COCl$  in the presence of a catalyst such as aluminium chloride and in an inert organic solvent such as 1,1,2,2-tetrachloroethane and at a temperature from  $0^{\circ}C$  to the reflux temperature of the reaction mixture.

When Z is an amino group it may also be acylated and subsequent hydrolysis using an acid such as hydrochloric or hydrobromic acid in a solvent such as dioxan or acetic acid may be necessary.

Compounds of general formula I wherein Y represents  $-C(=O)R^{18}$  may also be prepared by the reaction of nitriles of the general formula I wherein Y represents  $-CN$  with an organometallic reagent such as a compound of general formula  $R^{18}MgX^1$  in an inert organic solvent such as diethyl ether or tetrahydrofuran, at a temperature from  $0^{\circ}C$  to reflux.

Compounds of general formula IC may be prepared by the reaction of a compound of general formula I wherein Y represents the thiocyanato group with an organometallic reagent such as a compound of general formula  $RMgX^1$  in an inert organic solvent such as

diethyl ether or tetrahydrofuran, and at a temperature from ambient temperature to the reflux temperature of the reaction mixture.

Compounds of general formula IC wherein RS is other than a 1-alkenylthio group may also be prepared by reacting a compound of general formula I wherein Y represents the thiocyanato group with a base, preferably sodium hydroxide, or a reducing agent, preferably sodium borohydride, in the presence of a reagent of general formula  $R'X^1$  wherein  $R'$  is as hereinbefore defined for R with the exclusion of 1-alkenyl groups, for example methyl iodide in an inert organic or aqueous-organic solvent such as an alcohol e.g. ethanol or a mixture of an alcohol and water, the reaction being performed at a temperature from ambient to reflux.

Alternatively compounds of general formula IC wherein RS is other than a 1-alkenylthio group may be prepared by reductive alkylation of disulphides of general formula XVII employing a reducing agent preferably sodium dithionite or sodium borohydride, in the presence of a base, preferably sodium hydroxide or sodium carbonate, and of a reagent of general formula  $R'X^1$  such as methyl iodide in an inert organic or aqueous-organic solvent such as an alcohol e.g. ethanol or a mixture of an alcohol and water, at a temperature from ambient to reflux.

Alternatively compounds of general formula IC may be prepared from a halide of general formula I wherein Y represents a bromine or iodine atom by metal exchange using a strong base, preferably butyllithium, and subsequent addition of the appropriate disulphide of general formula R-S-S-R in an inert organic solvent such as tetrahydrofuran, and the reaction is performed at a temperature from -78°C to ambient.

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Alternatively, compounds of general formula IC wherein RS represents a straight- or branched-chain alkylthio group containing from 1 to 6 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms may be prepared by reacting a compound of general formula XI with an alkanesulphenyl halide (which may be optionally substituted by one or more halogen atoms) in an inert organic solvent, preferably chloroform, in the presence of a base such as pyridine, and at temperatures from 0° to reflux.

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Compounds of general formula IC wherein RS represents a methylthio group which is substituted by three halogen atoms which may be the same or different may also be prepared by the reaction of a compound of general formula I wherein Y represents the thiocyanato group with a source of halogenocarbene, such as chloroform and sodium hydroxide, preferably with phase transfer catalysis using for example benzyl-triethylammonium chloride or tetrabutylammonium chloride.

Compounds of general formula IC wherein RS represents a straight- or branched-chain alkylthio group containing from 1 to 6 carbon atoms which is substituted by one or more fluorine atoms may also be prepared by a halogen exchange reaction of a compound of general formula IC wherein RS represents a straight- or branched-chain alkylthio group containing from 1 to 6 carbon atoms which is substituted by one or more chlorine atoms with a fluorinating agent such



as a mixture of antimony trifluoride and antimony pentachloride, KF or CsF in an aprotic solvent such as sulfolane at a temperature from 50°C to reflux.

5 Compounds of general formula I wherein Y represents the thiocyanato group may be prepared by the reaction of a compound of general formula XI with a thiocyanating agent such as alkali metal or ammonium salts of thiocyanic acid (e.g. NaSCN) and bromine in an inert organic solvent such as methanol, and at a  
10 temperature from 0°C to 100°C.

Intermediates of general formula XVII may be prepared by hydrolysis of thiocyanates of general formula I wherein Y represents the thiocyanato group, preferably using hydrochloric acid in the presence of  
15 ethanol at a temperature from ambient to reflux temperature; they may also be prepared by reduction of the thiocyanates by sodium borohydride in an alcohol preferably ethanol at a temperature from ambient to reflux.

20 Compounds of general formula I wherein Y represents a group RSO may be prepared by the oxidation of compounds of general formula IC by an oxidising reagent preferably 3-chloroperbenzoic acid in an inert organic solvent such as dichloromethane  
25 or by hydrogen peroxide in acetic acid at a temperature from 0°C to the reflux temperature of the reaction medium.

Compounds of general formula I wherein Y represents a group  $\text{RSO}_2$  may also be prepared by the above process, by employing an excess of the oxidising agent.

Compounds of general formula I wherein Y represents a group  $\text{RSO}_2$  wherein R represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which is substituted by one or more fluorine atoms may also be prepared by a halogen exchange reaction of a compound of general formula I wherein Y represents a group  $\text{RSO}_2$  wherein R represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which is substituted by one or more chlorine atoms with a fluorinating agent such as a mixture of antimony trifluoride and antimony pentachloride,  $\text{KF}$  or  $\text{CsF}$  at a temperature from  $50^\circ\text{C}$  to  $200^\circ\text{C}$ .

Compounds of general formula I wherein Y represents a group  $\text{RSO}_2$  may also be prepared by reaction of a compound of general formula XI with the appropriate sulphonic anhydride of general formula  $(\text{RSO}_2)_2\text{O}$  for example trifluoromethanesulphonic or methanesulphonic anhydride and in the presence of aluminium chloride as catalyst, and employing an inert organic solvent such as 1,1,2,2-tetrachloroethane at a temperature from ambient to  $150^\circ\text{C}$ .

Compounds of general formula I wherein Z represents a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms, the carboxy group, a group  $R^{19}S$  wherein  $R^{19}$  represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which may be unsubstituted or substituted by one or more halogen atoms or Z represents a trialkylsilyl group containing from 1 to 6 carbon atoms in each alkyl group which may be the same or different may be prepared by the reaction of a compound of general formula I wherein Z represents a hydrogen, bromine or iodine atom with a lithiating agent preferably lithium diisopropylamide or n-butyl lithium, and reaction with the appropriate substrate from alkyl halide, carbon dioxide, dialkylsulphides or trialkylsilyl halides respectively at a temperature from  $-78^{\circ}C$  to ambient temperature, and in an inert solvent, preferably tetrahydrofuran.

Compounds of general formula I wherein Z represents a hydrogen atom may be prepared by diazotisation of an amine of general formula I wherein Z represents the unsubstituted amino group using an alkyl nitrite, preferably tert-butyl nitrite, in an inert solvent preferably tetrahydrofuran, at a temperature from ambient temperature to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Z represents a group  $R^{19}SO$  may be prepared by the reaction of a compound of general formula I wherein Z represents a group  $R^{19}S$  with an oxidising agent, preferably 3-chloroperbenzoic acid in a solvent such as dichloromethane, or by hydrogen peroxide in acetic acid at a temperature from  $0^{\circ}C$  to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Z represents a group  $R^{19}SO_2$  may also be prepared by the above process, by employing an excess of the oxidising agent.

Compounds of general formula I wherein Z represents the fluorine atom or the cyano group may be prepared by the reaction of a halide of general formula I wherein Z represents the chlorine or bromine atom with an alkali metal fluoride, preferably caesium fluoride, or with an alkali metal cyanide preferably KCN, under anhydrous conditions in an inert solvent, preferably sulfolane, and at a temperature from ambient temperature to  $150^{\circ}C$ .

Compounds of general formula I wherein Z represents the nitro group may be prepared by oxidation of amines of general formula I wherein Z represents the unsubstituted amino group with an oxidant, preferably trifluoroperacetic acid or m-chloroperbenzoic acid and in an inert organic solvent preferably dichloromethane at a temperature from 0°C to reflux.

Compounds of general formula I wherein Z represents the cyano group may be prepared by dehydration of the corresponding amide preferably by heating with phosphorous pentoxide at a temperature from 50°C to 250°C.

The amides may be prepared (i) by reacting a carboxylic acid of general formula I wherein Z represents a carboxy group with a chlorinating agent preferably thionyl chloride, and (ii) reacting the resultant acid chloride of general formula XVIII with ammonia:-

(i) the reaction with a chlorinating agent preferably thionyl chloride is generally conducted at a temperature from ambient temperature to the reflux temperature of the reaction mixture;  
(ii) the reaction with ammonia is generally conducted in a solvent which may be inert, preferably toluene, or in the presence of water, and at a temperature from 0°C to 100°C.

Compounds of general formula I wherein Y represents a group  $\text{RSO}_2$  is other than a 1-alkenylsulphonyl group may be prepared alternatively by reaction of sulphinate metal (e.g. sodium) salts with a reagent of general formula  $\text{R}'\text{X}^1$  or preferably a sulphate of general formula  $(\text{R}')_2\text{SO}_4$ , in a solvent such as water and in the presence of sodium bicarbonate at a temperature from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ .

The intermediate sulphinate sodium salts may be prepared by reaction of sulphonyl chlorides of general formula XIV with sodium sulphite in the presence of sodium bicarbonate and water as solvent, at a temperature from  $50^\circ\text{C}$  to reflux.

Intermediates of general formula XIV may also be prepared from the thiocyanates of general formula I wherein Y represents a thiocyanato group by chlorination using chlorine in a solvent, preferably water, at a temperature from ambient to reflux.

Compounds of general formula I wherein  $\text{R}^3$  represents a haloalkylsulphonyl group may be prepared by oxidation of a haloalkylthio derivative of general formula I, preferably with m-chloroperbenzoic and in an inert organic solvent preferably dichloromethane, at a temperature from  $0^\circ\text{C}$  to reflux.

Compounds of general formula I wherein  $\text{R}^3$  represents a haloalkylsulphonyl group may be prepared in a similar manner, by employing two molar equivalents of oxidant.

Compounds of general formula I wherein Y represents the fluorine atom may be prepared by diazotisation of corresponding amines using sodium nitrite in tetrafluoroboric acid and sulphuric acid at a temperature from  $-10^{\circ}\text{C}$  to  $+10^{\circ}\text{C}$ , followed by photolysis in the presence of excess sodium tetrafluoroboric acid at a temperature from  $-30^{\circ}\text{C}$  to ambient.

Intermediate amines above may be prepared by reduction of nitro compounds of general formula I wherein Y represents a nitro group, preferably with zinc in ethanol at a temperature from ambient to reflux.

Compounds of general formula I wherein Y represents the methyl group may be prepared by reduction of an acid of general formula XVI using a reducing agent, preferably borane-tetrahydrofuran complex in a solvent preferably tetrahydrofuran at a temperature from  $-30^{\circ}\text{C}$  to reflux.

Compounds of general formula I wherein Z represents a trialkylsilylmethyl group as hereinbefore defined may be prepared by the reaction of a compound of general formula I wherein Z represents the methyl group with a lithiating agent preferably lithium diisopropylamide or n-butyl lithium, and reaction with a trialkylsilyl halide at a temperature from  $-78^{\circ}\text{C}$  to ambient, and in an inert organic solvent preferably tetrahydrofuran, optionally in an inert atmosphere.

The following processes optionally followed by the subsidiary processes hereinbefore described permit the preparation of the remaining compounds of general formula I not described above, as well as some whose preparation is described above.

Compounds of general formula I wherein  $R^4$  represents a chlorine, bromine or iodine atom and Z represents the unsubstituted amino group, may be prepared by the diazotisation of the (diamino) compounds of general formula I in which Z represents and  $R^4$  is replaced by amino, using a molar equivalent of sodium nitrite in a mineral acid, for example a mixture of concentrated sulphuric acid and acetic acid, at a temperature from 0 to 60°C, and by subsequent reaction with the appropriate copper salt and appropriate mineral acid or with an aqueous solution of potassium iodide (when  $R^4$  represents an iodine atom) at a temperature from 0 to 100°C.

The diamino compounds above wherein Y represents the cyano group may be prepared by the reaction of potassium cyanoform  $KC(CN)_3$  with a phenylhydrazine of general formula II in the presence of hydrochloric acid, at a temperature from 50°C to the reflux temperature of the reaction mixture.



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Compounds of general formula I wherein  $R^4$  represents the fluoromethyl group may be prepared by reacting a compound of general formula XII with a fluorinating agent, preferably diethylaminosulphur trifluoride, in an inert organic solvent, preferably dichloromethane, at a temperature from  $-78^\circ\text{C}$  to the reflux temperature of the reaction mixture.

Intermediates of general formula XII may be prepared by reduction of compounds of general formula XIX preferably with lithium borohydride in an inert organic solvent e.g. tetrahydrofuran at a temperature from  $0^\circ\text{C}$  to the reflux temperature of the reaction mixture.

Intermediates of general formulae XIX (wherein  $R^{20}$  represents an alkyl group) and XX wherein Z represents the unsubstituted amino group may be obtained by the reaction of a compound of the general formula XIII (wherein  $R^0$  represents an alkoxy group) with a molar equivalent of compound of general formula  $Y'\text{CH}_2\text{CN}$ , i.e. malononitrile when Y represents the cyano group, in the presence of an anhydrous solvent, e.g. ethanol, and a molar equivalent of a base, e.g. sodium hydride, and at a temperature from 0 to  $50^\circ\text{C}$  followed, if desired, by hydrolysis of the esters of general formula XIX with an aqueous base, e.g. sodium hydroxide, with a co-solvent, e.g. ethanol, at a temperature from  $0^\circ\text{C}$  to the reflux temperature of the reaction mixture.

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Intermediates of general formulae IV and XIII may be prepared by chlorination of the appropriate unsubstituted compound using chlorine or other chlorinating agent.

5 Intermediates of general formulae IV and XIII may be prepared by diazotisation of the appropriate aniline with a solution of a molar equivalent of sodium nitrite in a mineral acid, e.g. a mixture of concentrated sulphuric acid and acetic acid at a  
10 temperature from 0 to 60°C, and then reacting with the compound of formula  $\text{CH}_3\text{COCH}(\text{Cl})\text{CN}$  or a compound of general formula  $\text{CH}_3\text{COCH}(\text{Cl})\text{COR}^0$  wherein  $\text{R}^0$  represents an alkoxy group in the presence of an inert solvent, e.g. a mixture of water and ethanol,  
15 buffered, e.g. with excess sodium acetate, and at a temperature from 0 to 50°C.

Compounds of general formula I wherein  $\text{R}^4$  represents the nitro group may be prepared by  
20 oxidation of the corresponding amine with an oxidant, preferably trifluoroperacetic acid or m-chloro-perbenzoic acid in an inert organic solvent preferably dichloromethane at a temperature from 0°C to reflux. By employing known protecting agents in this process  
25 compounds of general formula I wherein Z represents the amino group may be prepared.

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Compounds of general formula I wherein  $R^4$  represents the fluorine atom may be prepared by the diazotisation of the corresponding amine of general formula I in which  $R^4$  is replaced by  $-NH_2$  using  
5 for example a solution of sodium nitrite in a mineral acid, for example sulphuric acid and in the presence of fluoroboric acid or its sodium salt and subsequent thermolysis or photolysis of the diazonium fluoroborate derivative by methods known per se.

10 Amine intermediates above wherein Z represents the hydrogen atom may be prepared by performing a Curtius rearrangement of the corresponding acid azide by heating in an inert organic solvent such as toluene at a temperature from  $50^\circ$  to  $150^\circ C$  to give an  
15 isocyanate which is then reacted with for example tert-butanol to give a carbamate, which in turn is hydrolysed using dilute acid preferably hydrochloric acid in ethanol at a temperature from ambient to reflux.

20 Intermediate acid azides may be prepared by reaction of a carboxylic acid of general formula XX wherein Z represents the hydrogen atom with a chlorinating agent, preferably thionyl chloride at temperatures from ambient to reflux, followed by  
25 reaction of the intermediate acid chloride with sodium azide in a polar solvent, preferably acetone and water at a temperature from  $0^\circ C$  to ambient.

Compounds of general formula I wherein  $R^4$  represents the cyano group may also be prepared by reacting a carboxylic acid of general formula XX with a chlorinating agent, preferably thionyl chloride at ambient to reflux temperature, followed by reaction of the intermediate acid chloride with ammonia to give an intermediate amide which is then dehydrated by heating with a dehydrating reagent, preferably phosphorus pentoxide at a temperature from 50-250°C.

Intermediates of general formula XX may be prepared by hydrolysis of the corresponding esters of general formula XIX preferably using a base such as sodium hydroxide and a solvent such as aqueous alcohol, and at a temperature from 0°C to the reflux temperature of the reaction mixture.

Compounds of general formula I wherein Y represents a 1,1-difluoroalkyl group which may be substituted by one or more additional halogen atoms may be prepared by the reaction of a compound of general formula I wherein Y represents a straight- or branched-chain alkanoyl group containing from 2 to 6 carbon atoms or the corresponding compound in which Y is replaced by the formyl group or a straight- or branched-chain alkanoyl group containing from 2 to 6 carbon atoms which is substituted by one or more halogen atoms with a fluorinating agent, preferably

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diethylazinosulphur trifluoride or sulphur tetrafluoride in an inert organic solvent, preferably dichloromethane, at a temperature from  $-78^{\circ}\text{C}$  to ambient.

5       Compounds of general formula I wherein Y represents the trifluoromethyl group or a trifluoromethylalkyl group containing from 2 to 6 carbon atoms which may be substituted by one or more additional halogen atoms may be prepared by the  
10       reaction of a fluorinating agent, e.g. sulphur tetrafluoride, with an acid of general formula XVI or the corresponding carboxyalkyl compound (it being understood that the carboxy group may be attached to  
15       any position of the alkyl moiety) at a temperature from ambient to  $150^{\circ}\text{C}$ .

Salts with pesticidally-acceptable bases of compounds of general formula I wherein Z represents the carboxy group may be prepared from the corresponding compounds of general formula I by  
20       methods known per se, for example by reacting stoichiometric quantities of the compound of general formula I and the appropriate base, for example an alkali metal hydroxide, carbonate or bicarbonate, an alkaline earth metal hydroxide or carbonate, ammonia  
25       or an amine (e.g. diethanolamine, triethanolamine, octylamine, morpholine or dioctylamine), in a suitable solvent. The salts may, if necessary, be purified by recrystallisation from one, two or more suitable solvents.

Compounds of general formula I not hitherto disclosed or described in the chemical literature, together with their processes of preparation form further features of the present invention.

5       The present invention accordingly provides the compounds of general formula I, wherein the various symbols are as hereinbefore defined, and salts thereof, with the exclusion of the compounds wherein:  $R^4$  and Z both represent methyl, Y represents  
10       thiocyanato and  $(R^3)_n$  represents 2-, 3- or 4-nitro, 4-methyl, 4-chloro or 2,4-dinitro substitution;  $R^4$  represents methyl, Y represents cyano, Z represents unsubstituted amino and  $(R^3)_n$  represents 4-chloro, 2,4-dichloro, 3,4-dichloro,  
15       3-chloro-4-methyl or 2-methyl-4-chloro substitution;  $R^4$  represents methyl, Y represents cyano or  $CCNH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3- or 4-fluoro substitution;  $R^4$  represents ethyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$   
20       represents 3- or 4-chloro, 2-, 3- or 4-fluoro or methyl, 3-bromo or 3-nitro substitution;  $R^4$  represents propyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$   
25       represents 3-fluoro substitution;  $R^4$  represents methyl, Y represents sulphamoyl, Z represents chloro and  $(R^3)_n$  represents 4-chloro substitution;  $R^4$

represents methyl, Y represents nitro, and Z represents chloro or  $R^4$  represents chloro, Y represents nitro, and Z represents methyl and  $(R^3)_n$  represents 4-nitro; and  $R^4$  represents nitro, Y represents cyano or  $CONH_2$ , Z represents hydrogen and  $(R^3)_n$  represents 4-nitro substitution.

According to a further feature of the present invention there are provided intermediates for the preparation of certain compounds of general formula I i.e. compounds for which in their alternative meanings Y represents the hydrogen atom, the formyl or carboxy group, a straight- or branched-chain alkanoyl group containing from 2 to 6 carbon atoms which is substituted by one or more halogen atoms, the dithio group (which joins two pyrazole rings), the amino group, the  $-SO_2Cl$  group, a straight- or branched-chain carboxyalkyl group containing from 2 to 6 carbon atoms, Z represents the carbamoyl group or a straight- or branched-chain alkoxycarbonyl group containing from 2 to 7 carbon atoms or the diphenoxycarbonylamino group,  $(R^3)_n$  substitution is a preferred combination given earlier in the specification or  $R^4$  represents the amino, hydroxymethyl, carboxy or carbamoyl group or a straight- or branched-chain alkoxycarbonyl or alkoxycarbonylamino group containing from 2 to 7 carbon atoms.

The following Examples and Reference Examples illustrate the preparation of compounds of general formula I according to the present invention:-

EXAMPLE 1

5 Compound No.1

A mixture of 2,4,6-trichlorophenylhydrazine (21.1 g) and tetracyanoethylene (13.3 g) in ethanol (100 ml) was heated at reflux for 15 minutes. The reaction mixture was cooled and the solid precipitate was filtered off and washed with diethyl ether to give 5-amino-3,4-dicyano-1-(2,4,6-trichlorophenyl)pyrazole (13 g), as a buff coloured solid, m.p. 267-271°C.

EXAMPLE 2

Compounds Nos.2 and 3

15 Tetracyanoethylene (1.9 g) and 2,6-dichloro-4-trifluoromethylphenylhydrazine (3.7 g) was added to a magnetically-stirred solution of sodium acetate (0.6 g) in glacial acetic acid (15 ml) at laboratory temperature. After stirring for 15 minutes, a colourless solid precipitated from the solution and stirring was continued overnight. The mixture was then filtered. The solid obtained was washed successively with acetic acid, water, aqueous sodium bicarbonate solution and water, to give 25 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole (2.5 g), as beige crystals, m.p. 221-222°C.



By proceeding in a similar manner, but replacing the 2,6-dichloro-4-trifluoromethylphenylhydrazine by 2,3,5,6-tetrachlorophenylhydrazine, there was obtained:-

5 5-Amino-3,4-dicyano-1-(2,3,5,6-tetrachlorophenyl)-pyrazole, m.p. greater than 330°C, in the form of a buff-coloured powder.

#### REFERENCE EXAMPLE 1

10 Phenylhydrazines used as starting materials in Examples 1, 2 and 11, not hitherto described in the chemical literature were prepared as follows:-

2,6-Dichloro-4-trifluoromethylphenylaniline (4.3 g) was dissolved with stirring, in glacial acetic acid (23 ml). A solution of sodium nitrite (1.5 g) in concentrated sulphuric acid (11 ml) was then added at 15 55-60°C. The solution thus obtained was cooled to 0-5°C and a solution of stannous chloride (16.4 g) in concentrated hydrochloric acid (14 ml) was added with vigorous stirring. A cream-coloured solid precipitated. The mixture was filtered and the solid 20 obtained was added to a mixture of aqueous ammonia solution and ice. The mixture thus obtained was extracted with diethyl ether (6 x 500 ml) and the combined ethereal extracts were dried over sodium 25 sulphate, filtered and evaporated to dryness to give 2,6-dichloro-4-trifluoromethylphenylhydrazine (3.7 g) m.p. 54-56°C, in the form of a colourless crystalline solid.

By proceeding in a similar manner, but replacing the 2,6-dichloro-4-trifluoromethylaniline by the hereinafter indicated aniline there were prepared:-

2-Chloro-4-trifluoromethylphenylhydrazine, m.p. 38-39°C, in the form of a colourless solid, from 2-chloro-4-trifluoromethylaniline.

### EXAMPLE 3

#### Compound No.4

Ethoxyethylenemalononitrile (44.5g) and 2,6-dichloro-4-trifluoromethylphenylhydrazine (80.0g) were added to a stirred solution of sodium acetate (13.4g) in glacial acetic acid (110 ml) at laboratory temperature. A thick suspension was obtained and was stirred overnight, after which a dark solution had formed. The solvent was evaporated in vacuo, and the residue was diluted with aqueous sodium bicarbonate solution (100ml) and extracted with dichloromethane (3 x 100ml), and the combined extracts were washed with sodium bicarbonate solution (50ml), then with water (100ml), dried over anhydrous magnesium sulphate and evaporated in vacuo to give a dark syrup. This was heated at reflux with 2-ethoxyethanol (200ml) for 1 hour, and then evaporated in vacuo to give a dark oil. The oil was dissolved in dichloromethane, washed with sodium bicarbonate solution (50ml), then with water (100ml), dried over anhydrous magnesium sulphate, treated with charcoal, and evaporated in vacuo to give

a black solid. The solid was recrystallised twice from a mixture of toluene and petroleum ether (b.p. 60-80°C) to give 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (49.3g), m.p. 194-196°C, in the form of pale brown crystals.

#### EXAMPLE 4

##### Compounds Nos. 5, 22, 24 and 36

To a mechanically stirred solution of 2,6-dichloro-4-trifluoromethylphenylhydrazine (180.3 g) in dry diethyl ether (700 ml) was added anhydrous potassium carbonate (112 g), and the mixture was cooled to 0°C. To this mixture was added dropwise during half-an-hour a solution of 2-chloro-1,1-dicyano-2-trifluoromethylethylene (132.1 g) in dry diethyl ether (350 ml). The ice-bath was removed at the end of the reaction, and the mixture was left overnight and then poured onto water (2000 ml). The ethereal layer was separated and the aqueous solution extracted with diethyl ether (2 x 300 ml). The combined extracts were dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo to give a buff solid (350 g). Recrystallisation from toluene/hexane gave white crystals (169.5 g) m.p. 202-204°C of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole.

By proceeding in a similar manner, but replacing the 2-chloro-1,1-dicyano-2-trifluoromethylethylene by 2-chloro-1-cyano-1-methanesulphonyl-2-trifluoromethylethylene there was prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole in the form of buff crystals m.p. 215-218°C, from toluene-hexane.

By proceeding in a similar manner, but replacing the 2-chloro-1,1-dicyano-2-trifluoromethylethylene by 2-chloro-1-cyano-1-methoxycarbonyl-2-trifluoromethylethylene there was prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methoxycarbonyl-3-trifluoromethylpyrazole in the form of fawn crystals, m.p. 114-115°C, from hexane.

By proceeding in a similar manner, but replacing the 2,6-dichloro-4-trifluoromethylphenylhydrazine by 2,6-dichloro-4-trifluoromethoxyphenylhydrazine there was prepared:-

5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethoxyphenyl)-3-trifluoromethylpyrazole in the form of white crystals, m.p. 160-160.5°C from toluene-hexane.

EXAMPLE 5Compounds Nos. 19, 20, 21 and 47

5           Anhydrous sodium acetate (0.246 g) was added  
to a stirred solution of 2-chloro-1,1-dicyano-  
2-pentafluoroethylethylene (1.38 g) in acetic acid  
(5 ml). To this mixture was added  
2,6-dichloro-4-trifluoromethylphenylhydrazine (1.47 g)  
during 5 minutes. After stirring overnight the  
mixture was neutralised with sodium bicarbonate  
10       solution, and extracted with dichloromethane (2 x 50  
ml). The combined extracts were washed with water,  
dried over anhydrous magnesium sulphate, filtered, and  
evaporated in vacuo to give a buff solid (2.1 g).  
This solid was heated under reflux with  
15       2-ethoxyethanol (10 ml) for 1 hour, and evaporated in  
vacuo to give a brown oil (2.2 g). This oil was  
chromatographed on silica (Merck, 230-400 mesh, 0.7 kg  
 $\text{cm}^{-2}$ ) using a mixture of dichloromethane and ethyl  
acetate (98:2) to give a yellow solid.  
20       Recrystallisation from a mixture of dichloromethane  
and petroleum ether gave 5-amino-4-cyano-  
1-(2,6-dichloro-4-trifluoromethylphenyl)-3-pentafluoro-  
ethylpyrazole as white crystals, m.p. 160-162°C.

25           By proceeding in a similar manner, but  
replacing the 2-chloro-1,1-dicyano-2-pentafluoro-  
ethyl-ethylene by 2-chloro-1,1-dicyano-2-chloro-  
difluoromethylethylene there was prepared:-

5-Amino-3-chlorodifluoromethyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole in the form of white prisms, m.p. 192°C, from toluene-hexane.

5 By proceeding in a similar manner, but replacing the 2-chloro-1,1-dicyano-2-pentafluoroethylethylene by 2-chloro-1,1-dicyano-2-difluoromethylethylene there was prepared:-

10 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-difluoromethylpyrazole in the form of a colourless solid, m.p. 184.5°C (from toluene-petroleum ether).

15 By proceeding in a similar manner, but replacing the 2-chloro-1,1-dicyano-2-pentafluoroethylethylene by 2-chloro-1,1-dicyano-2-heptafluoropropylethylene there was prepared:-

20 5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-heptafluoropropylpyrazole in the form of colourless prisms, m.p. 139-140°C (from toluene-petroleum ether).

#### REFERENCE EXAMPLE 2

25 Chloro-dicyanoethylenes used as starting materials in the above Examples, not hitherto described in the chemical literature were prepared as follows:-

A suspension of 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt (18.56 g) in dichloromethane (60 ml) was stirred at room temperature and treated with phosphorus pentachloride (19.27 g). The suspension was heated under reflux for 6 hours, cooled and filtered, and the filtrate was distilled. A Widmer fractionating column was used to give 2-chloro-1,1-dicyano-2-chlorodifluoromethyl-ethylene as a liquid, b.p. 88°C (44 mmHg) (71 g).

By proceeding in a similar manner, but replacing 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt by 2-cyano-3-hydroxy-4,4-difluorobut-2-enenitrile sodium salt there was prepared 2-chloro-1,1-dicyano-2-difluoromethyl-ethylene as a liquid, b.p. 94°C (46 mmHg).

By replacing 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt by 3-hydroxy-2-methanesulphonyl-4,4,4-trifluorobut-2-enenitrile sodium salt and proceeding in a similar manner there was prepared 2-chloro-1-cyano-1-methanesulphonyl-2-trifluoromethylethylene as a pale brown liquid.

By replacing 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt by 3-hydroxy-2-methoxycarbonyl-4,4,4-trifluorobut-2-enenitrile sodium salt and proceeding in a similar manner there was prepared 2-chloro-1-cyano-1-methoxycarbonyl-2-trifluoromethylethylene as a colourless oil, b.p. 86-92°C at 23-25 mm Hg.

By replacing 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt by 2-cyano-3-hydroxy-4,4,5,5,6,6,6-heptafluorohex-2-enenitrile sodium salt and proceeding in a similar manner there was prepared 2-chloro-1,1-dicyano-2-heptafluoropropyl-ethylene as a pale yellow liquid, b.p. 110°C at 60 mmHg.

### REFERENCE EXAMPLE 3

The sodium salts used in the above Reference Examples as starting materials, not hitherto described in the chemical literature were prepared as follows:-

To a solution of sodium methoxide (5.61 g) in anhydrous methanol (70 ml) was added malononitrile (6.85 g) and the yellow solution treated with methyl chlorodifluoroacetate (15 g). The mixture was heated under reflux for 4 hours, the solvent was evaporated in vacuo and re-evaporated after addition of toluene to give 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt as a brown solid (18.9g). This was dried in a vacuum desiccator.

By proceeding in a similar manner, but replacing methyl chlorodifluoroacetate by ethyl difluoroacetate there was obtained 2-cyano-3-hydroxy-4,4-difluorobut-2-enenitrile sodium salt as a light brown solid.

By proceeding in a similar manner, but replacing methyl chlorodifluoroacetate by methyl



trifluoroacetate, and the malononitrile by methane-sulphonylacetonitrile there was obtained 3-hydroxy-2-methanesulphonyl-4,4,4-trifluorobut-2-enenitrile sodium salt as a brown solid.

5 By proceeding in a similar manner, but replacing methyl chlorodifluoroacetate by methyl-trifluoroacetate, and the malononitrile by methyl-cyanoacetate there was obtained 3-hydroxy-2-methoxycarbonyl-4,4,4-trifluorobut-2-enenitrile sodium salt  
10 as a buff solid.

By proceeding in a similar manner, but replacing methyl chlorodifluoroacetate by methyl-heptafluorobutyrate there was obtained 2-cyano-3-hydroxy-4,4,5,5,6,6,6-heptafluorohex-2-enenitrile  
15 sodium salt as a light brown hygroscopic solid.

#### EXAMPLE 6

##### Compound No.23

To stirred 80% sulphuric acid (22 ml) was added 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (3.98 g) at  
20 80°C. After 1 hour the cooled solution was poured onto ice and extracted with dichloromethane (3x). The combined extracts were washed with water, dried over anhydrous magnesium sulphate, filtered, and  
25 evaporated in vacuo to give a white solid. This solid was recrystallised from ethyl acetate-petroleum ether to give 5-amino-4-carbamoyl-1-(2,6-dichloro-

4-trifluoromethylphenyl)-3-trifluoromethylpyrazole  
(3.5 g), m.p. 169-171°C in the form of white crystals.

#### EXAMPLE 7

##### Compounds Nos. 6, 7 and 8

5 3,5-Diamino-4-cyano-1-(2,6-dichloro-4-tri-  
fluoromethylphenyl)pyrazole (3.9g; prepared as  
described below) was dissolved with stirring in  
glacial acetic acid (60ml) at 15°C. A solution of  
sodium nitrite (0.88g) in concentrated sulphuric acid  
10 (5.85ml) was then added over 5 minutes, maintaining at  
15°C. After 15 minutes longer at this temperature,  
the dark red oil solution was poured during 1 minute  
onto a stirred solution of cuprous chloride (2.32g) in  
concentrated hydrochloric acid (36ml). After 15  
15 minutes at laboratory temperature, by which time the  
evolution of nitrogen had completely subsided, the  
reaction mixture was poured onto excess ice and water,  
and extracted with dichloromethane (3 x 50ml). The  
combined extracts were washed with water (2 x 50ml),  
20 then with sodium bicarbonate solution (50ml), dried  
over anhydrous magnesium sulphate, and evaporated in  
vacuo to give a brown semi-solid (4.1g).

Chromatography on silica (Merck, 230-400 mesh,  
0.7 kg cm<sup>-2</sup>) using a mixture of dichloromethane and  
25 ethyl acetate (98:2) as eluent gave after evaporation  
of the eluate and recrystallisation of the residue  
from a mixture of dichloromethane and petroleum ether

(b.p. 60-80°C) 5-amino-3-chloro-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole (0.95g), m.p. 189-191°C, in the form of white crystals.

By proceeding in a similar manner but replacing the cuprous chloride and concentrated hydrochloric acid by cuprous bromide and 48% w/v hydrobromic acid respectively there was prepared:-

5-Amino-3-bromo-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole, m.p. 182-183°C, in the form of white crystals.

By replacing the cuprous chloride and concentrated hydrochloric acid by a solution of potassium iodide in water there was prepared:-

5-Amino-3-iodo-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole, m.p. 208-210°C, in the form of white crystals.

#### REFERENCE EXAMPLE 4

A suspension of 2,6-dichloro-4-trifluoromethylphenylhydrazine (14.7g) in water (40ml) was stirred with concentrated hydrochloric acid (5.2ml), and potassium cyanoforn (8.52g) added. The suspension was stirred and heated under reflux for 16 hours, and left to cool overnight. The mixture was washed into a separating funnel with the aid of ethyl acetate and water, and the organic phase collected. The aqueous phase was re-extracted with ethyl acetate (2 x 80ml), and the combined organic solutions washed with water

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(2 x 50ml), dried over anhydrous magnesium sulphate, and evaporated in vacuo to give an orange solid (20.9g). Two recrystallisations from a mixture of ethyl acetate and petroleum ether (b.p. 60-80°C) gave  
5 3,5-diamino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole (7.75g), m.p. 208-210°C in the form of white crystals.

#### EXAMPLE 8

##### Compound No.9

the 10 A solution of ethanethiol (2.1g) in toluene (10ml) was added dropwise at 5-10°C to a stirred suspension of N-chlorosuccinimide (4.7g) in toluene (40ml). The reaction mixture was filtered after 20 minutes to give a solution of ethanesulphenyl  
15 chloride. This filtrate was added dropwise with stirring to a solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole sodium salt [prepared in situ by reaction of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (5g) with sodium hydride (0.4g)] in  
20 tetrahydrofuran (50ml) containing 15-crown-5 (3 drops) at a temperature of 5-10°C. After 2 hours, aqueous sodium bicarbonate solution (50ml) was added, and the organic phase was separated and washed with water (2 x  
25 50ml), and dried over anhydrous magnesium sulphate. Evaporation of the solvent in vacuo gave a dark brown gum, which was chromatographed on silica (Merck

230-400 mesh,  $0.7 \text{ kg cm}^{-2}$ ) using dichloromethane as eluent. Evaporation of the eluates gave an orange gum, which then recrystallised from a mixture of ethyl acetate and hexane to give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-ethanesulphenylamino-  
5 pyrazole (2.3g), m.p.  $160-161^{\circ}\text{C}$ , in the form of a pale yellow solid.

#### EXAMPLE 9

##### Compounds Nos. 10, 11 and 27

10 A mixture of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (5g) and p-toluenesulphonic acid hydrate (0.1g) in trimethylorthoformate (20ml) was heated at reflux for 4.5 hours. After cooling, the reaction mixture was  
15 evaporated to dryness in vacuo. The residue was dissolved in diethyl ether and left to crystallise at  $0^{\circ}\text{C}$ . The dark coloured solid was recrystallised from a mixture of ethanol and water to give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-methoxymethyleneaminopyrazole (4.67g), m.p.  $75-78^{\circ}\text{C}$ ,  
20 in the form of buff crystals.

By proceeding in a similar manner but replacing the trimethylorthoformate by tripropylorthoformate there was prepared:-

25 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-propoxymethyleneaminopyrazole, m.p.  $77-79^{\circ}\text{C}$ , in the form of buff crystals.

230-400 mesh,  $0.7 \text{ kg cm}^{-2}$ ) using dichloromethane as eluent. Evaporation of the eluates gave an orange gum, which then recrystallised from a mixture of ethyl acetate and hexane to give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-ethanesulphenylamino-  
 5 pyrazole (2.3g), m.p.  $160-161^{\circ}\text{C}$ , in the form of a pale yellow solid.

#### EXAMPLE 9

##### Compounds Nos. 10, 11 and 27

10 A mixture of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (5g) and  
 15 p-toluenesulphonic acid hydrate (0.1g) in trimethylorthoformate (20ml) was heated at reflux for 4.5 hours. After cooling, the reaction mixture was  
 20 evaporated to dryness in vacuo. The residue was dissolved in diethyl ether and left to crystallise at  $0^{\circ}\text{C}$ . The dark coloured solid was recrystallised from a mixture of ethanol and water to give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-methoxymethylenaminopyrazole (4.67g), m.p.  $75-78^{\circ}\text{C}$ ,  
 in the form of buff crystals.

By proceeding in a similar manner but replacing the trimethylorthoformate by tripropylorthoformate there was prepared:-

25 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-propoxymethylenaminopyrazole, m.p.  $77-79^{\circ}\text{C}$ , in the form of buff crystals.

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buff-coloured solid (23.0g). Recrystallisation from a mixture of ethyl acetate and petroleum ether (b.p. 60-80°C) gave 5-acetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, m.p. 208-209°C, in the form of white crystals.

By proceeding in a similar manner, the following phenylpyrazoles were obtained by acylation of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole with the appropriate acid chloride:-

5-Dichloroacetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, m.p. 186-187°C after purification by trituration with carbon tetrachloride and subsequent recrystallisation from a mixture of ethanol and water, in the form of an off-white solid. The reaction was performed at laboratory temperature.

5-Cyclopropylcarbonamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, m.p. 217-218°C after recrystallisation from a mixture of ethanol and water, in the form of an off-white solid. The reaction was performed at laboratory temperature.

5-Pentanamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole in the form of a pale yellow glass. Infra-Red Absorption bands: 3260, 3100, 2960, 2940, 2880, 2240, 1730, 1700, 1315, 880, 820  $\text{cm}^{-1}$  (liquid film). The reaction was

performed at 0°C during the addition, and at laboratory temperature thereafter.

5 5-Propionamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, m.p. 188-189°C after purification by chromatography on silica (Merck, 230-400 mesh, 0.7 kg cm<sup>-2</sup>) using a mixture of acetone and hexane (2:3) as eluent, and subsequent trituration with toluene, in the form of a white powder. The reaction was performed at laboratory  
10 temperature.

By proceeding in a similar manner, but replacing the solvent by acetonitrile, the following phenylpyrazole was obtained by acylation of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyano-  
15 pyrazole with trimethylacetyl chloride:-

1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-(2,2-dimethylpropionamido)pyrazole as white crystals, m.p. 202-203°C from toluene-hexane, and after purification by chromatography on silica (Merck,  
20 230-400 mesh, 0.7 kg cm<sup>-2</sup>) using a mixture of dichloromethane and ethyl acetate (9:1) as eluent.

By proceeding in a similar manner but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole by 5-amino-4-cyano-1-(2,6-  
25 dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole and by heating under reflux for 18 hours there was obtained:-



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5-Acetanido-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole, m.p. 225-227°C, from ethyl acetate-hexane, in the form of white crystals.

5

EXAMPLE 11Compounds Nos.17 and 18

Anhydrous sodium acetate (1.0g) was dissolved in stirred acetic acid (40ml), and tetracyanoethylene (3.5g) was added at laboratory temperature. 2-Chloro-4-trifluoromethylphenylhydrazine (5.25g) was added in one portion, and the mixture was stirred overnight. After dilution with water, the precipitated solid was filtered off to give, after drying, 5-amino-1-(2-chloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, m.p. 209-210°C in the form of a white powder.

15

By proceeding in a similar manner but replacing the 2-chloro-4-trifluoromethylphenylhydrazine by 2,3,5,6-tetrafluoro-4-trifluoromethylphenylhydrazine and with cooling during addition of the phenylhydrazine to the tetracyanoethylene solution, there was prepared:-

20

5-amino-3,4-dicyano-1-(2,3,5,6-tetrafluoro-4-trifluoromethylphenyl)pyrazole, m.p. 262-263°C in the form of a buff powder.

25

EXAMPLE 12

Compounds Nos.28 and 29

Sodium hydride (80%, 0.25 g) was added to a stirred solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (2.9 g) in dry tetrahydrofuran (50 ml). After 3 hours at room temperature, 15-crown-5 (1 drop) and methyl iodide (2 g) was added at 0°C, and the mixture left overnight at room temperature. The solution was evaporated in vacuo, and the residue was dissolved in dichloromethane (50 ml), washed with water, dilute hydrochloric acid and water. After drying over anhydrous magnesium sulphate, filtration, and evaporation in vacuo a yellow oil was obtained. Purification by chromatography using Merck silica (230-400 mesh,  $0.7 \text{ kg cm}^{-2}$ ) with dichloromethane as eluent gave 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-dimethylamino-3-trifluoromethylpyrazole as a white solid, m.p. 105-107°C.

By proceeding in a similar manner but replacing the methyl iodide by ethyl bromoacetate, and employing dioxan as solvent in place of tetrahydrofuran there was obtained 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-ethoxycarbonyl-methylamino-3-trifluoromethylpyrazole as white crystals, m.p. 104-106°C from ethyl acetate-petroleum ether.

EXAMPLE 13

Compound No.30

To a suspension of 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-ethoxymethyleneamino-3-trifluoromethylpyrazole (1.0 g) in methanol (10 ml) stirred at room temperature was added sodium borohydride (0.17 g). After 2 hours-an-additional 0.17 g of sodium borohydride was added, and another 0.34 g added after 1 hour. One hour later the mixture was poured onto water (80 ml) and extracted with dichloromethane (3 x 25 ml). The combined extracts were dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo. The white solid thus obtained was purified by chromatography on silica (Merck, 230-400 mesh,  $0.7 \text{ kg cm}^{-2}$ ) with dichloromethane as eluent, to furnish 4-cyano-5-methylamino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole as a white solid (0.6 g), m.p. 200-202°C.

EXAMPLE 14

Compounds Nos.31, 37 and 38

Sodium hydride (80%, 0.3 g) was added to a stirred solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (2.9 g) in dry tetrahydrofuran (50 ml). After 3 hours, 15-crown-5 (1 drop) and trimethylacetyl chloride (1.8 g) was added, and the mixture stirred

overnight. Evaporation in vacuo gave a buff semisolid, which was dissolved in dichloromethane. This solution was washed with water, dilute hydrochloric acid and with water again and finally dried over anhydrous magnesium sulphate. Filtration followed by evaporation in vacuo gave a yellow oil, which was purified by chromatography on silica (Merck, 40-230 mesh,  $0.7 \text{ kg cm}^{-2}$ ). Elution with dichloromethane gave after evaporation 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-(2,2-dimethylpropionamido)-3-trifluoromethylpyrazole as a white solid, m.p.  $198-200^{\circ}\text{C}$ .

By proceeding in a similar manner but replacing the trimethylacetyl chloride by ethyl chloroformate there was obtained, after recrystallisation from toluene, 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(ethoxycarbonyl)amino-3-trifluoromethylpyrazole as white crystals, m.p.  $62^{\circ}\text{C}$ .

By proceeding in a similar manner but replacing the trimethylacetyl chloride by cyclopropanecarboxylic acid chloride there was obtained 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis-(cyclopropanecarbonyl)amino-3-trifluoromethylpyrazole as a pale yellow solid, m.p.  $126-127^{\circ}\text{C}$ .

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EXAMPLE 15Compound No.39

A solution of 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(cyclopropanecarbonyl)-amino-3-trifluoromethylpyrazole (1.0 g) in ethanol (50 ml) was heated under reflux with saturated sodium bicarbonate solution (25 ml) for 45 minutes. After cooling, and evaporation of the solvent in vacuo, the residue was diluted with water and extracted with dichloromethane. The extract was dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo to give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-cyclopropanecarbonamido-3-trifluoromethylpyrazole as a white solid m.p. 210-212°C.

EXAMPLE 16Compound No.33

A stirred mixture of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (3.89 g) and bromoform (13 ml) was treated with tert-butyl nitrite (2.26 ml) at room temperature. After 15 minutes the mixture was heated to 50°C for 1 hour, and evaporated in vacuo to yield a red oil. This was purified by chromatography on silica (Merck, 40-230 mesh, 0.7 kg cm<sup>-2</sup>) eluting with a mixture of dichloromethane and petroleum ether (1:2) to furnish 5-bromo-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole as a fawn solid m.p. 85-87°C (3.7 g).

EXAMPLE 17Compound No.34

5 A solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-hydroxymethylpyrazole (1.25 g) in dichloromethane (10 ml) was added slowly to a stirred solution of diethylaminosulphur trifluoride (0.66 g) in dichloromethane (6 ml) cooled to -78°C. After 30 minutes at this temperature the solution was warmed to room temperature and stirred for 2 hours. The mixture was then poured onto water (20 ml) and the dichloromethane layer was separated, dried over anhydrous magnesium sulphate, filtered and evaporated in vacuo. The product was purified by chromatography on silica (Merck, 40-230 mesh, 15 0.7 kg cm<sup>-2</sup>) eluting with a mixture of dichloromethane and ethyl acetate (98:2), and subsequent recrystallisation from dichloromethane-petroleum ether to give 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-fluoromethylpyrazole as a white solid 20 m.p. 139-141°C.

REFERENCE EXAMPLE 5

5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-hydroxymethylpyrazole was prepared as follows:-

25 A solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-ethoxycarbonylpyrazole (1.0 g) in dry tetrahydrofuran (15 ml) was

5 treated under nitrogen with lithium borohydride  
(0.06 g) with stirring at room temperature for 18  
hours. Ethyl acetate (5 ml) followed by saturated  
sodium chloride solution (5 ml) was added, and the  
10 mixture was acidified with dilute hydrochloric acid  
and extracted with dichloromethane. The extract was  
dried over anhydrous magnesium sulphate, filtered, and  
evaporated in vacuo. The residual oil was purified  
by chromatography on silica (Merck, 40-230 mesh,  
10 0.7 kg cm<sup>-2</sup>) eluting with a mixture of  
dichloromethane and ethyl acetate (1:1), and the pure  
fractions were evaporated in vacuo and recrystallised  
from ethyl acetate-petroleum ether to give the title  
compound as a white solid m.p. 159-161°C

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5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoro-  
methylphenyl)-3-ethoxycarbonylpyrazole was prepared as  
follows:-

To sodium hydride (80%, 0.9 g) in dry ethanol  
20 (30 ml) was added, with stirring, malononitrile  
(1.98 g). Ethyl chloro-(2,6-dichloro-4-trifluoro-  
methylphenyl)hydrazono-acetate (11.0 g) was then added  
with stirring and cooling. The internal temperature  
quickly rose to 20°C and was kept at that for 1 hour.  
25 before filtration of the pale yellow solid. The  
filtrate was evaporated in vacuo to give an orange  
solid. The combined solids were dissolved in ethyl

acetate, washed twice with water, dried over anhydrous magnesium sulphate, filtered and evaporated in vacuo to give an orange solid (11.0 g). Recrystallisation from ethyl acetate-petroleum ether gave the title compound as fawn crystals (8.3 g) m.p. 208-209°C.

-----  
Ethyl chloro-(2,6-dichloro-4-trifluoromethyl-phenyl)hydrazonoacetate was prepared as follows:-

Sodium nitrite (3.04 g) was added during 15 minutes to stirred concentrated sulphuric acid (24 ml) at 30-50°C. The solution was cooled to 20°C, and added dropwise during 15 minutes to a solution of 2,6-dichloro-4-trifluoromethylaniline (9.2 g) in acetic acid (90 ml), maintaining at 35-40°C. This solution was then cooled to +10°, and added dropwise to a stirred solution of anhydrous sodium acetate (54 g) and ethyl chloroacetoacetate (7.0 g) in a mixture of water (72 ml) and ethanol (48 ml) during 45 minutes with cooling such that the temperature was kept at 10°C. After 1 hour at room temperature the mixture was diluted with water, filtered, and the solid dissolved in dichloromethane. This solution was dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo to give the title compound as a white solid (11.9 g) m.p. 96-98°C.



EXAMPLE 18Compounds Nos. 32 and 40

A mixture of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole  
(3.64 g) and N-bromosuccinimide (1.78 g) in carbon  
tetrachloride (30 ml) was stirred and heated under  
reflux for 1 hour. Further N-bromosuccinimide  
(0.89 g) was added, and reflux was continued for a  
further 1 hour. The mixture was cooled, filtered,  
and the filtrate was evaporated in vacuo to give an  
orange solid. Recrystallisation from petroleum ether  
gave  
5-amino-4-bromo-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-trifluoromethylpyrazole in the form of white  
crystals (2.6 g) m.p. 119-120°C.

By proceeding in a similar manner but  
replacing N-bromosuccinimide by N-chlorosuccinimide  
there was obtained 5-amino-4-chloro-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoromethylpyrazole as  
white crystals m.p. 99-100°C. No excess of  
chlorinating agent was required in this case.

REFERENCE EXAMPLE 6

5-Amino-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-trifluoromethylpyrazole was prepared as  
follows:-

A solution of 5-amino-4-carboxy-1-  
(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoro-

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methypyrazole (10.5 g) in N,N-dimethylaniline (13 ml) was heated under reflux for 3 hours. The cooled mixture was poured onto concentrated hydrochloric acid (15 ml) and extracted with ether (4 x 30 ml). The combined extract was washed with 6N hydrochloric acid (3 x 30 ml), with water (2 x 30 ml), dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo. The product was recrystallised from cyclohexane to give the title compound (5.7 g) as white needles m.p. 126-128°C.

5-Amino-4-carboxy-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole was prepared as follows:-

A mixture of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methoxycarbonyl-3-trifluoromethylpyrazole (101.2 g; hereinbefore described in Example 4) and sodium hydroxide (48 g) in water (170 ml) and methanol (550 ml) was stirred at room temperature for 2 days, evaporated in vacuo, and the residue triturated with dilute hydrochloric acid. The solid was filtered, dissolved in ethyl acetate, and the resulting solution was washed with sodium chloride solution. After drying over anhydrous magnesium sulphate, filtration, and evaporation in vacuo a semisolid residue was obtained. This residue was triturated with hexane and the solid was recrystallised from toluene-hexane to give the title compound as a cream solid, m.p. 212-215°C.

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EXAMPLE 19Compound No.41

5 Ethyl chloroformate (1.6 g) was added to a stirred solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (3.9 g) in pyridine (15 ml). After stirring overnight another addition of ethyl chloroformate (1.0 ml) was made, and the mixture was left for a further 12 hours. The solvent was evaporated in vacuo and the residue was acidified with dilute hydrochloric acid, and extracted with dichloromethane. This extract was washed with water (3x), dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo. Purification by chromatography on silica (Merck, 40-230 mesh, 0.7 kg cm<sup>-2</sup>) eluting with ethyl acetate - petroleum ether (1:1) gave a white solid, which was recrystallised from a mixture of dichloromethane and hexane to furnish white crystals of 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-ethoxycarbonylamino-3-trifluoromethylpyrazole, m.p. 177-179°C.

EXAMPLE 20Compound No.35

25 A solution of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (3.0 g) in concentrated sulphuric acid (10 ml) at 0°C was treated with fuming nitric acid (9 ml) during 15

minutes, keeping the temperature at 5-15°C. After 30 minutes the mixture was poured onto excess ice, and the precipitated solid was filtered off and dissolved in ethyl acetate. After drying over anhydrous magnesium sulphate, filtration, and evaporation in vacuo a brown oil was obtained. This oil was dissolved in the minimum of ethyl acetate and diluted with hexane. A pale yellow solid crystallised and this was discarded. The filtrate was evaporated in vacuo to give a solid which was recrystallised from toluene-hexane to furnish a yellow solid. One further recrystallisation from the same solvent pair gave 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole as white crystals, m.p. 214-215°C.

#### EXAMPLE 21

##### Compound No.42

To a solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (2.33 g) in dry tetrahydrofuran (30 ml) was added with stirring at room temperature, a solution of tert-butyl nitrite (1.36 ml) in dry tetrahydrofuran (5 ml) during 2 minutes. The solution was then heated under reflux for 1 hour and cooled, and additional tert-butyl nitrite (2.72 ml) was added. The solution was heated under reflux for 30 minutes, and left to cool

overnight. Evaporation in vacuo gave an orange oil, which was purified by chromatography on silica (Merck, 40-230 mesh,  $0.7 \text{ kg cm}^{-2}$ ) eluting with dichloromethane-hexane (1:1). The product was finally recrystallised from hexane to give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole, m.p.  $121-123^{\circ}\text{C}$ , as white crystals.

EXAMPLE 22

10 Compound No.43

To a solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (2.33 g) in chloroform (30 ml) stirred at room temperature, was added iodine (3.0 g) followed by tert-butyl nitrite (1.1 g). After 2 hours the mixture was heated under reflux for 1.5 hours, cooled and filtered, and the filtrate was washed with sodium thiosulphate solution to remove excess iodine. After washing with water, drying over anhydrous magnesium sulphate and evaporation in vacuo, a yellow solid was obtained. This was chromatographed on silica (Merck, 40-230 mesh,  $0.7 \text{ kg cm}^{-2}$ ) eluting with dichloromethane-hexane (1:2) to give a yellow oil. Dissolution in hot hexane gave, on cooling, 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-iodo-3-trifluoromethylpyrazole as white crystals, m.p.  $86-87^{\circ}\text{C}$ .

EXAMPLE 23Compound No. 44

To dry diisopropylamine (0.135 g) in dry tetrahydrofuran (4 ml) stirred at  $-78^{\circ}\text{C}$  under nitrogen, was added via a syringe, a solution of n-butyl lithium (0.52 ml of a 2.6 M solution in hexane). After warming to room temperature during 1 minute, the solution was re-cooled to  $-78^{\circ}\text{C}$ , and added via a syringe to a stirred solution of 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (0.5 g) in dry tetrahydrofuran (4 ml) under nitrogen at  $-78^{\circ}\text{C}$ . The addition, during 2 minutes, was exothermic and the internal temperature was maintained at  $-60^{\circ}\text{C}$  for a further 15 minutes. Methyl iodide (0.1 ml) was added. After 1.5 hours at this temperature the solution was poured onto excess water and extracted with dichloromethane (3x). The combined organic phase was washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a solid. Chromatography on silica (Merck, 40-230 mesh,  $0.7\text{ kg cm}^{-2}$ ) eluting with dichloromethane-hexane (1:3) gave a white solid (0.2 g). Recrystallisation from hexane furnished 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methyl-3-trifluoromethylpyrazole as white crystals, m.p.  $90-92^{\circ}\text{C}$ .

EXAMPLE 24

Compound No.45

A mixture of 5-amino-4-chlorosulphonyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (1.2 g) and dimethylamine (17.6 ml of a 40% aqueous solution) was heated on a steam bath for 1 hour, cooled, and poured onto crushed ice (50 g) to give a brown solid. This solid was filtered, dried, and recrystallised from toluene to give 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-(N,N-dimethylsulphamoyl)-3-trifluoromethylpyrazole (0.8 g) as light brown crystals, m.p. 177.6-178.6°C.

REFERENCE EXAMPLE 7

5-Amino-4-chlorosulphonyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole used in the above example was prepared as follows:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (9.1 g) was added portionwise to stirred cooled chlorosulphonic acid (16.2 ml), keeping the internal temperature below 10°C. The orange solution was stirred at room temperature for 30 minutes, then at 120°C for 5 hours, and poured onto iced water (300 ml) to give a pale brown solid. This solid was filtered, dried, and recrystallised from cyclohexane to give the title compound as yellow crystals.

EXAMPLE 25

Compound No.46

A solution of 2,6-dichloro-4-trifluoromethyl-phenylhydrazine (3.8 g) and 1,1-dicyano-2-cyclopropyl-2-methoxyethylene (2.23 g) in methanol (30 ml) was stirred and treated with sodium hydride (80%, 30 mg). After 4 hours the solution was evaporated in vacuo and the residue was dissolved in ethyl acetate (40 ml), treated with charcoal and washed with water. The organic phase was evaporated in vacuo, the residual oil was dissolved in petroleum ether and crystals of 5-amino-4-cyano-3-cyclopropyl-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole, m.p. 197-199°C, were obtained.



EXAMPLE 26

Compounds Nos. 48, 49 and 50

By proceeding in a similar manner to that hereinbefore described in Example 1, but replacing  
5 2,4,6-trichlorophenylhydrazine by 2,6-dichloro-4-trifluoromethylthiophenylhydrazine, there was obtained:-

5-Amino-3,4-dicyano-1-(2,6-dichloro-4-trifluoromethylthiophenyl)pyrazole, m.p. 226-227°C,  
10 in the form of an off-white solid, after recrystallisation from toluene.

By employing 2-chloro-3,5,6-trifluoro-4-trifluoromethylphenylhydrazine there was prepared:-

5-Amino-1-(2-chloro-3,5,6-trifluoro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole,  
15 m.p. 242-243°C, in the form of an orange solid, after recrystallisation from a mixture of ethanol and water.

By employing 2,6-dichloro-3,5-difluoro-4-trifluoromethylphenylhydrazine there was prepared:-

20 5-Amino-1-(2,6-dichloro-3,5-difluoro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, m.p. 245-247°C, in the form of an off-white solid.

REFERENCE EXAMPLE 8

25 2,6-Dichloro-4-trifluoromethylthiophenylhydrazine was prepared by following the procedure of Reference Example 1, by proceeding in a similar manner, but replacing the 2,6-dichloro-4-trifluoromethylaniline by 2,6-dichloro-4-trifluoromethylthioaniline.

REFERENCE EXAMPLE 9

2-Chloro-3,5,6-trifluoro-4-trifluoromethyl-phenylhydrazine was prepared as follows:-

3-Chloro-2,4,5,6-tetrafluorobenzotrifluoride  
5 (12.1 g) and hydrazine hydrate (3.4 g) were heated under reflux with ethanol (50 ml) for 3.5 hours. The mixture was poured onto ice/water mixture (500 ml), stirred, and the product was filtered. After washing with water and drying in a desiccator the title  
10 compound was obtained in the form of white crystals, m.p. 91-92°C.

By proceeding in a similar manner but replacing 3-chloro-2,4,5,6-tetrafluorobenzotrifluoride by 3,5-dichloro-2,4,6-trifluorobenzotrifluoride there was  
15 prepared 2,6-dichloro-3,5-difluoro-4-trifluoromethylphenylhydrazine in the form of pale yellow crystals, m.p. 78-80°C.

EXAMPLE 27

Compound No. 51

20 By proceeding in a similar manner to that hereinbefore described in Example 2, but employing 2,6-dichloro-4-trifluoromethoxyphenylhydrazine there was obtained:-

25 5-Amino-1-(2,6-dichloro-4-trifluoromethoxyphenyl)-3,4-dicyanopyrazole, m.p. 231-232°C in the form of a brown solid, after recrystallisation from toluene.

REFERENCE EXAMPLE 10

2,6-Dichloro-4-trifluoromethoxyphenylhydrazine used in the above Example 27 was prepared by following the procedure of Reference Example 1, by proceeding in a similar manner, but replacing the 2,6-dichloro-4-trifluoromethylaniline by 2,6-dichloro-4-trifluoromethoxyaniline. The title compound was obtained as fawn crystals, m.p. 64-65°C.

EXAMPLE 28

Compounds Nos. 52, 53, 54 and 55

By proceeding in a similar manner to that hereinbefore described in Example 3, but replacing the ethoxyethylenemalononitrile by ethoxypropylene-malononitrile there was prepared:-

5-Amino-4-cyano-3-ethyl-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole in the form of white crystals, m.p. 158-160°C, after recrystallisation from a mixture of ethyl acetate and hexane.

By proceeding in a similar manner but replacing the ethoxyethylenemalononitrile by ethoxyethylenemethanesulphonylacetonitrile, and by replacing the sodium acetate and glacial acetic acid by ethanol containing 10 mol % of triethylamine at reflux, there was prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-methylpyrazole in the form of a white solid, m.p. 195°C, after recrystallisation from a mixture of ethyl acetate and hexane.

By proceeding in a similar manner but replacing the ethoxyethylenemalononitrile by ethoxyethylenecyanoacetic acid ethyl ester there was prepared:-

5        5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-ethoxycarbonylpyrazole in the form of white crystals, m.p. 115-118°C after recrystallisation from a mixture of toluene and petroleum ether.

10        By proceeding in a similar manner but replacing the ethoxyethylenemalononitrile by ethoxyethylenemethanesulphonylacetonitrile, and by replacing the 2,6-dichloro-4-trifluoromethylphenylhydrazine by 2,6-dichloro-4-trifluoromethoxyphenylhydrazine and by  
15        performing the reaction in a 1:1 v/v mixture of ethanol and triethylamine at ambient temperature, there was obtained:-

20        5-Amino-1-(2,6-dichloro-4-trifluoromethoxy-phenyl)-4-methanesulphonyl-3-methylpyrazole, in the form of a fawn solid, m.p. 180-181°C.

REFERENCE EXAMPLE 11

3-Ethoxy-2-methanesulphonylbut-2-ene-nitrile, used in the above Example 28 was prepared as follows:-

25        A mixture of methanesulphonylacetonitrile (200 g), triethylorthoacetate (348 g) and zinc chloride (21 g) was stirred in hexane (1200 ml) with heating under reflux. The distillate was collected via a McIntyre head, with additional hexane added to the reaction mixture as necessary. Hexane (2800 ml) was collected

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during 8 hours. After cooling, the mixture was evaporated in vacuo, and re-evaporated after addition of toluene (100 ml). The residue was dissolved in ethyl acetate and recrystallised from a mixture of ethyl acetate with hexane, twice, to give white crystals, m.p. 99°C, of the title compound.

#### EXAMPLE 29

Compounds Nos. 56, 57, 58 and 59

By proceeding in a similar manner to that hereinbefore described in Example 4, but replacing the 2,6-dichloro-4-trifluoromethylphenylhydrazine by 2-chloro-3,5,6-trifluoro-4-trifluoromethylphenylhydrazine there was obtained:-

5-Amino-1-(2-chloro-3,5,6-trifluoro-4-trifluoromethylphenyl)-4-cyano-3-trifluoromethylpyrazole, in the form of white crystals, m.p. 187-189°C, after recrystallisation from toluene.

By employing 2,6-dichloro-4-trifluoromethylthiophenylhydrazine there was obtained:-

5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylthiophenyl)-3-trifluoromethylpyrazole, in the form of pale yellow crystals, m.p. 133.5-134.5°C, after recrystallisation from hexane.

By replacing the 2-chloro-1,1-dicyano-2-trifluoromethylethylene by 2,3-dichloro-1,1-dicyano-3-fluoromethylethylene there was obtained:-

5-Amino-3-chlorofluoromethyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole in the form of a cream solid, m.p. 186-188°C, after recrystallisation from a mixture of toluene and hexane.

By employing 2,6-dichloro-3,5-difluoro-4-trifluoromethylphenylhydrazine there was obtained:-

5-Amino-4-cyano-1-(2,6-dichloro-3,5-difluoro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole in the form of a light brown solid, m.p. 176-177°C.

#### REFERENCE EXAMPLE 12

Chloro-dicyanoethylene used as starting material in the above Example 29, not hitherto described in the chemical literature was prepared as follows:-

By proceeding in a similar manner to that hereinbefore described in Reference Example 2, but replacing 2-cyano-3-hydroxy-4-chloro-4,4-difluorobut-2-enenitrile sodium salt by 2-cyano-3-hydroxy-4-chloro-4-fluorobut-2-enenitrile sodium salt there was prepared 2-chloro-2-chlorofluoromethyl-1,1-dicyanoethylene as a liquid, b.p. 90°C (46 mm-Hg).

By proceeding in a similar manner to that hereinbefore described in Reference Example 3, but replacing methyl chlorodifluoroacetate by ethyl chlorofluoroacetate, there was obtained 2-cyano-3-hydroxy-4-chloro-4-fluorobut-2-enenitrile sodium salt as an orange-red solid.

EXAMPLE 30

Compound No. 60

By proceeding in a similar manner to that hereinbefore described in Example 9, but replacing the trimethylorthoformate by triethylorthoacetate there was prepared:-

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-(1-ethoxyethylideneamino)-3-methylpyrazole as a white solid, m.p. 50-53°C, after purification by chromatography on silica (Merck 230-400 mesh, 0.7 kg cm<sup>-2</sup>) using dichloromethane as eluent.

EXAMPLE 31

Compounds Nos. 61, 62 and 63

By proceeding in a similar manner to that hereinbefore described in Example 10, but replacing the 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-methylpyrazole and acylating with succinyl dichloride there was obtained:-

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-5-succinimidopyrazole in the form of a white solid, m.p. 202-204°C, after purification by chromatography on silica (Merck 230-400 mesh, 0.7 kg cm<sup>-2</sup>) using dichloromethane/ethyl acetate (98:2) as eluent.

By proceeding in a similar manner but replacing the 5-amino-1-(2,6-dichloro-4-trifluoro-methylphenyl)-3,4-dicyanopyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole, and employing acetonitrile as solvent for the acylation, there was prepared:-

5-Acetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole in the form of a white solid, m.p. 194-195°C, after recrystallisation from toluene.

By proceeding in a similar manner (to Example 10) but replacing the 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-methanesulphonylpyrazole there was prepared 5-acetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-methanesulphonylpyrazole in the form of yellow crystals, m.p. 202-203°C.

#### EXAMPLE 32

##### Compound No. 64

By proceeding in a similar manner to that hereinbefore described in Example 11, but replacing the 2-chloro-4-trifluoromethylphenylhydrazine by 2,6-dichloro-4-nitrophenylhydrazine there was prepared:-

5-Amino-1-(2,6-dichloro-4-nitrophenyl)-3,4-dicyanopyrazole, in the form of a pale brown solid, m.p. 289-290°C.



EXAMPLE 33

Compounds Nos. 65 and 66

By proceeding in a similar manner to that hereinbefore described in Example 12, but replacing the  
5 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole and using an appropriate quantity of methyl iodide there was prepared:-

10 1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-methylaminopyrazole in the form of a pale yellow solid, m.p. 165-166°C, after recrystallisation from toluene.

By proceeding as above, but employing ethyl iodide,  
15 there was prepared:-

1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-ethylaminopyrazole in the form of an off-white solid, m.p. 245-246°C, after purification by chromatography on silica (Merck 230-400 mesh, 0.7 kg  
20 cm<sup>-2</sup>) using a mixture of ethyl acetate and petroleum ether (15:85).

EXAMPLE 34

Compounds Nos. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76.  
77. 78 and 79

By proceeding in a similar manner to that hereinbefore described in Example 14, but replacing the 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole and the trimethylacetyl chloride by the following phenylpyrazoles and acylating agents, there were prepared:-

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-(N-methyl-N-ethoxycarbonylamino)-3-trifluoromethylpyrazole in the form of a white solid, m.p. 88-90°C, after recrystallisation from hexane, using 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methylamino-3-trifluoromethylpyrazole and ethyl chloroformate;

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-(N-acetyl-N-trimethylacetylamino)-3-trifluoromethylpyrazole in the form of an off-white solid, m.p. 83.5-84°C, after recrystallisation from hexane, using 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-trimethylacetylamino-3-trifluoromethylpyrazole and acetyl chloride;

4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-5-(N-propionyl-N-trimethylacetyl-amino)-3-trifluoromethylpyrazole in the form of a white solid, m.p. 56-56.5°C, after recrystallisation from hexane,

5 using 4-cyano-1-(2,6-dichloro-4-trifluoro-methylphenyl)-5-trimethylacetyl-amino-3-trifluoromethyl-pyrazole and propionyl chloride;

1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethyl-5-trimethylacetyl-amino-pyrazole in the form of a white solid, m.p. 219°C, 10 using 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole and trimethylacetyl chloride;

1-(2,6-Dichloro-4-trifluoromethylphenyl)-5-ethoxycarbonylamino-4-nitro-3-trifluoromethylpyrazole 15 in the form of pale yellow crystals, m.p. 124°C, using 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole and ethyl chloroformate;

20 and 3-Chloro-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-5-trimethylacetylaminopyrazole, in the form of a white solid, m.p. 203-204°C;

3-Chloro-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-5-bis(ethoxycarbonyl)aminopyrazole, in 25 the form of an orange crystalline solid, m.p. 67-69°C;

and 3-Chloro-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-cyano-5-ethoxycarbonylamino-pyrazole, in the form of a yellow solid, m.p. 175-179°C;

[The latter three compounds were obtained by reaction of 5-amino-3-chloro-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole with the appropriate acyl chlorides]

4-Cyano-5-diacetyl-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole in the form of white crystals, m.p. 138-139°C; and 5-(N-Acetyl-N-ethoxycarbonylamino)-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole in the form of a white solid, m.p. 101-102°C;

[The above two compounds were obtained by reaction of 5-acetyl-amino-1-(2,6-dichloro-4-trifluoromethyl)-4-cyano-3-trifluoromethylpyrazole and the appropriate acyl chlorides] and

1-(2,6-Dichloro-4-trifluoromethylphenyl)-5-bis(ethoxycarbonyl)amino-3,4-dicyanopyrazole and 1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(ethoxycarbonyl)amino-4-methanesulphonyl-3-trifluoromethylpyrazole were prepared in a similar manner to the procedure described in Example 14, but replacing the

5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole and by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole respectively. The trimethylacetyl chloride was replaced by the appropriate quantity of ethylchloroformate (two equivalents) and 2 equivalents of sodium hydride were also used. The products were white crystals with m.p. 74-76°C, and 148-151°C, respectively.

#### EXAMPLE 35

##### Compounds Nos. 79 and 80

By proceeding in a similar manner to that hereinbefore described in Example 15, but replacing the 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(cyclopropanecarbonyl)amino-3-trifluoromethylpyrazole by 1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(ethoxycarbonyl)amino-4-methanesulphonyl-3-trifluoromethylpyrazole there was obtained:-

1-(2,6-Dichloro-4-trifluoromethylphenyl)-5-ethoxycarbonylamino-4-methanesulphonyl-3-trifluoromethylpyrazole in the form of a white solid, m.p. 138-141°C.

By proceeding in a similar manner but replacing the 4-cyano-1-(2,6-dichloro-4-trifluoro-methylphenyl)-5-bis(cyclopropanecarbonyl)amino-3-trifluoromethylpyrazole by 1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis(ethoxycarbonyl)amino-3,4-dicyanopyrazole there was obtained:-

1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-ethoxycarbonylaminopyrazole in the form of a white solid, m.p. 161-163°C.

EXAMPLE 36

Compounds Nos. 81 and 82

By proceeding in a similar manner to that hereinbefore described in Example 18, but replacing N-bromosuccinimide by N-iodosuccinimide there was obtained:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-iodo-3-trifluoromethylpyrazole in the form of a white solid, m.p. 129°C.

By replacing N-bromosuccinimide by N-iodosuccinimide, and replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (hereinafter described in Reference Example 13), there was obtained:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-iodo-3-methylpyrazole in the form of a buff solid, m.p. 108-109°C, after recrystallisation from hexane.

REFERENCE EXAMPLE 13

5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methylpyrazole was prepared as follows:-

5-Amino-4-carboxy-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (28 g) was heated to 190°C under nitrogen, and maintained at this temperature until gas evolution ceased. After cooling, the title compound was obtained (22 g) as a yellow gum.

5-Amino-4-carboxy-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole used above was prepared by proceeding in a similar manner to Reference Example 6 but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methoxycarbonyl-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethoxycarbonyl-3-methylpyrazole (hereinafter described in Example 28), and by performing the base hydrolysis at the reflux temperature in ethanol for 13 hours. The title compound was obtained as a white solid, m.p. 183-184°C.

EXAMPLE 37Compounds Nos. 83, 84 and 85

By proceeding in a similar manner to that hereinbefore described in Example 20, but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole, and

replacing the mixture of concentrated sulphuric and fuming nitric acids by concentrated nitric acid alone, there was obtained:-

5 5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-nitropyrazole in the form of orange crystals, m.p. 229-231°C, after recrystallisation from a mixture of toluene and petroleum ether.

By proceeding in a similar manner but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-trifluoromethylpyrazole by 5-acetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole, and replacing the mixture of concentrated sulphuric and fuming nitric acids by a mixture of acetic acid and acetic anhydride to which was added fuming nitric acid, there was obtained:-

15 5-Acetamido-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole in the form of a cream solid, m.p. 194-195°C.

By proceeding in a similar manner but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-trifluoromethylpyrazole by 1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole, and replacing the mixture of concentrated sulphuric and fuming nitric acids by acetic anhydride to which was added fuming nitric acid, there was obtained:-

25 1-(2,6-Dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole in the form of an orange solid, m.p. 110-112°C, after recrystallisation from a mixture of toluene and hexane.



REFERENCE EXAMPLE 14

1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
3-trifluoromethylpyrazole used in the above Example 37  
was prepared by the procedure described in Example 21  
by replacing 5-amino-4-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by  
5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-  
3-trifluoromethylpyrazole. The title compound was  
obtained as a pale yellow oil.

5-Acetamido-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-trifluoromethylpyrazole used in the above  
Example 37 was prepared by the procedure described in  
Example 15, but replacing the 4-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-5-bis(cyclopropanecarbonyl)-  
amino-3-trifluoromethylpyrazole by 5-bis(acetyl)amino-  
1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoro-  
methylpyrazole. The title compound was obtained as  
white crystals, m.p. 142-144°C, after recrystallisation  
from ethyl acetate and hexane.

5-Bis(acetyl)amino-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoromethylpyrazole,  
used above, was prepared by the procedure of Example 19  
but replacing 5-amino-4-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by  
5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-  
3-trifluoromethylpyrazole, and the ethyl chloroformate  
by acetyl chloride. The title compound was obtained  
as a white solid, m.p. 130-131°C.

EXAMPLE 38

Compound Nos. 86, 87 and 88

By proceeding in a similar manner to that  
hereinbefore described in Example 21, but replacing the  
5 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-trifluoromethylpyrazole by 5-amino-  
1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-  
4-methanesulphonylpyrazole, there was obtained  
1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-  
10 4-methanesulphonylpyrazole in the form of yellow  
crystals, m.p. 168-169°C.

By proceeding in a similar manner but replacing the  
5-amino-4-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by  
15 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-fluoropyrazole, there was obtained 4-cyano-  
1-(2,6-dichloro-4-trifluoromethylphenyl)-3-fluoro-  
pyrazole in the form of white crystals, m.p. 120-121°C.

1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
20 4-methanesulphonyl-3-trifluoromethylpyrazole was  
prepared in a similar manner by replacing 5-amino-  
4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-  
3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoro-  
25 methylpyrazole. The title compound was obtained in  
the form of white needles, m.p. 154-155°C.

EXAMPLE 39

Compound No. 89

By proceeding in a similar manner to that hereinbefore described in Example 22, but replacing the iodine by anhydrous cupric chloride, and by replacing the chloroform by anhydrous acetonitrile, there was obtained:-

5-Chloro-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-cyano-3-trifluoromethylpyrazole in the form of a yellow oil, after purification by chromatography on silica (Merck, 40-230 mesh,  $0.7 \text{ kg cm}^{-2}$ ) eluting with a mixture of dichloromethane and hexane (1:2). Infra-Red Absorption bands: 2260, 1495, 1405, 1325,  $1160 \text{ cm}^{-1}$  (liquid film)

EXAMPLE 40

Compound Nos. 90 and 91

By proceeding in a similar manner to that hereinbefore described in Example 24, but replacing the dimethylamine by the appropriate amines there was prepared the following phenylpyrazoles:-

5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-(N-ethylsulphamoyl)-3-trifluoromethylpyrazole in the form of a cream solid, m.p.  $200^{\circ}\text{C}$ , after recrystallisation from a mixture of toluene and petroleum ether.

5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-(N-methylsulphamoyl)-3-trifluoromethylpyrazole in the form of a light brown solid, m.p.  $199-200^{\circ}\text{C}$ , after recrystallisation from toluene.

EXAMPLE 41

Compounds Nos. 92 and 93

Trifluoroacetic anhydride (3.5 ml) was added dropwise to a stirred mixture of 85% w/v hydrogen peroxide solution (0.56 ml) in dichloromethane (15 ml) maintaining at 0-10°C. After warming to 20°C during 5 minutes, a solution of 3-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-cyanopyrazole (1.0 g; hereinafter described in Reference Example 15) in dichloromethane (10 ml) was added dropwise over 5 minutes. A temperature rise of 10°C was observed during the addition, and the mixture heated under reflux for 1.5 hours. After cooling, the solution was poured onto excess water, and the organic solution washed in turn with solutions of sodium bicarbonate and sodium bisulphite. Drying over anhydrous magnesium sulphate, followed by evaporation in vacuo gave a buff solid, which was purified by chromatography on silica (Merck, 40-230 mesh,  $0.7 \text{ kg cm}^{-2}$ ) eluting with dichloromethane. The resultant white solid was recrystallised from a mixture of dichloromethane and hexane to give 1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-nitropyrzazole as white crystals (0.7 g), m.p. 163-165°C.

By proceeding in a similar manner but replacing 3-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole (hereinbefore described in Example 2), there was obtained:-

1-(2,6-Dichloro-4-trifluoromethylphenyl)-3,4-dicyano-5-nitropyrazole as orange crystals, m.p. 138-140°C, after recrystallisation from cyclohexane.

#### REFERENCE EXAMPLE 15

3-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole was prepared as follows:-

A solution of 3-tert-butoxycarbonylamino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole (2.8 g) in ethanol (100 ml) was treated with 50% v/v hydrochloric acid (10 ml), and the mixture heated under reflux for 1 hour. After standing overnight at room temperature, sodium carbonate was added to pH 8, and the mixture extracted three times with dichloromethane. The extract was washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a buff solid. Recrystallisation from a mixture of ethyl acetate and petroleum ether gave the title compound (1.4 g) in the form of white crystals, m.p. 159-160°C.

3-tert-Butoxycarbonylamino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyanopyrazole was prepared as follows:-

A mixture of 3-carboxy-4-cyano-

1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole (11 g) and thionyl chloride (35 ml) and N,N-dimethylformamide (3 drops) was heated under reflux for 2 hours. The solvent was evaporated in vacuo, and re-evaporated in vacuo after addition of dry toluene (20 ml). The resultant gum was dissolved in dry acetone (50 ml) and stirred, whilst a solution of sodium azide (2.9 g) in water (15 ml) was added during 5 minutes keeping at 10-15°C. After 30 minutes the mixture was poured onto water (250 ml) and extracted with dichloromethane (3 x 80 ml). The combined extract was washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo at equal to or below 40°C to give a buff solid (13 g).

The resulting azide was dissolved in dry toluene (200 ml) and heated under reflux for half-an-hour, with smooth evolution of nitrogen. After cooling, this was treated with tert-butanol (40 g), and the mixture heated under reflux overnight. After evaporation in vacuo, the resulting brown oil (15 g) was purified by chromatography on silica (Merck, 230-400 mesh, 0.7 kg cm<sup>2</sup>) eluting with dichloromethane and ethyl acetate (98:2) to give the title compound (8.0 g) as a white solid, m.p. 154-155°C.

3-Carboxy-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)pyrazole was prepared as follows:-

A suspension of 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-ethoxycarbonylpyrazole  
5 (5.0 g) in ethanol (100 ml) was treated with a solution of sodium hydroxide (0.63 g) in water (15 ml) and stirred at room temperature for 1.5 hours. After evaporation in vacuo at equal to or below 40°C, the residue was dissolved in water (150 ml) and extracted  
10 with dichloromethane (1 x 100 ml). This extract was back-washed with water (2 x 50 ml), and the combined aqueous solutions brought to pH 1 with dilute hydrochloric acid, and then extracted with ethyl acetate (3 x 50 ml). This extract was dried over  
15 anhydrous magnesium sulphate, and evaporated in vacuo to give a buff solid (4.6 g). Recrystallisation from a mixture of toluene and hexane gave the title compound in the form of buff crystals (4.4 g), m.p. 203-205°C.

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-ethoxycarbonylpyrazole was prepared by  
20 following the method described in Example 21, and replacing 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-  
25 3-ethoxycarbonylpyrazole. The title compound was obtained in the form of buff crystals, m.p. 198-199°C.

EXAMPLE 42

Compounds Nos. 94, 95 and 96

Silver(I) fluoride (5 g) was added in portions during 40 minutes to a vigorously stirred solution of 1,1-dichloro-2,2-dicyanoethylene in acetonitrile (15 ml), maintained at 0-10°C by external cooling. The stirring was continued at room temperature for 1 hour, and the solid filtered off. The filtrate containing 1,1-difluoro-2,2-dicyanoethylene was stirred and cooled whilst a solution of 2,6-dichloro-4-trifluoromethylphenylhydrazine (4.9 g) in acetonitrile (15 ml) was added dropwise at 5°C. After stirring overnight the solid was filtered off and the filtrate evaporated in vacuo to give a dark orange oil (6 g). This was purified by chromatography on silica (Merck, 230-400 mesh, 10 lb in<sup>-2</sup>) eluting with dichloromethane to give a white solid. Recrystallisation from a mixture of cyclohexane and ethyl acetate gave 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-cyano-3-fluoropyrazole (0.9 g) as a white solid, m.p. 193-194°C.

By proceeding in a similar manner but replacing the 2,6-dichloro-4-trifluoromethylphenylhydrazine by 2,6-dichloro-4-trifluoromethoxyphenylhydrazine and by employing 1,1-dichloro-2,2-dicyanoethylene instead of 1,1-difluoro-2,2-dicyanoethylene, and by using diethyl ether as solvent, there was prepared



5-amino-3-chloro-1-(2,6-dichloro-4-trifluoromethoxy-phenyl)-4-cyanopyrazole in the form of a yellow solid, m.p. 175-177°C.

By proceeding as immediately above but replacing the 2,6-dichloro-4-trifluoromethoxyphenylhydrazine by 2,6-dichloro-3,5-difluoro-4-trifluoromethylphenylhydrazine, there was prepared 5-amino-3-chloro-4-cyano-1-(2,6-dichloro-3,5-difluoro-4-trifluoromethylphenyl)pyrazole, in the form of yellow crystals, m.p. 206-208°C.

EXAMPLE 43

Compounds Nos. 97, 98, 99, 100, 101, 102 and 103

A stirred solution of 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (1.5 g) in dry tetrahydrofuran cooled to -78°C was treated with a solution of n-butyl lithium (2.6 M in hexane, 1.71 ml) dropwise under nitrogen. The temperature was kept below -65°C during the addition, and the resultant solution kept at -78°C for 1 hour. A solution of trimethylsilyl chloride (0.56 ml) in dry tetrahydrofuran (2 ml) was then added, dropwise, during 2 minutes. The mixture was allowed to reach room temperature over 2 hours, left overnight and evaporated in vacuo to give a pale yellow solid. This was dissolved in dichloromethane, washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo. The product was recrystallised from hexane to

give 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethyl-5-trimethylsilylpyrazole as white crystals, m.p. 108-110°C.

By proceeding in a similar manner but replacing the trimethylsilyl chloride by the reagents listed below, the following phenylpyrazoles were obtained:-

5-tert-Butyldimethylsilyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole in the form of white crystals, m.p. 113-115°C; from tert-butyldimethylsilyl chloride.

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methylthio-3-trifluoromethylpyrazole, in the form of a white powder, m.p. 73-74°C; from methylthiocyanate.

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethyl-5-trifluoromethylthiopyrazole, in the form of white crystals, m.p. 120-122°C; from bis[trifluoromethyl]disulphide.

5-Carboxy-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole, in the form of a white solid, m.p. 177-179°C, by pouring the lithiated pyrazole solution onto a large excess of powdered solid carbon dioxide.

By proceeding in a similar manner but replacing the 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 1-(2,6-dichloro-4-trifluoromethylphenyl)-4-nitro-3-trifluoromethylpyrazole, there was prepared:-

1-(2,6-Dichloro-4-trifluoromethylphenyl)-  
4-nitro-3-trifluoromethyl-5-trimethylsilylpyrazole, in  
the form of a pale green solid, m.p. 101-103°C.

By proceeding in a similar manner but replacing the  
5 4-cyano-1-(2,6-dichloro-4-trifluoro-  
methylphenyl)-3-trifluoromethylpyrazole by  
4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-  
5-methyl-3-trifluoromethylpyrazole (hereinbefore  
described in Example 23), there was prepared:-

10 4-Cyano-1-(2,6-dichloro-4-trifluoromethyl-  
phenyl)-3-trifluoromethyl-5-trimethylsilylmethyl-  
pyrazole, in the form of a colourless oil.

Infra-Red Absorption bands: 2250, 1400, 1325, 1260,  
1180, 1150,  $860\text{cm}^{-1}$  (liquid film)

15 Nuclear Magnetic Resonance: chemical shift (delta) for  
 $-\text{Si}-\text{CH}_2-$  2.8ppm in dimethylsulphoxide- $\text{D}_6$ .

#### EXAMPLE 44

##### Compound No. 104

20 Sodium methoxide (0.3 g) was added to an ice cold  
stirred mixture of 4-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-5-bis(phenoxy carbonyl) amino-  
3-trifluoromethylpyrazole (3.1 g) in methanol (30 ml),  
and heated under reflux for 2 hours. This was poured  
25 onto water (200 ml) and extracted with  
dichloromethane. The organic solution was washed with  
sodium carbonate solution, then with water, dried over  
anhydrous magnesium sulphate, and evaporated in

vacuo. The resultant white solid was 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methoxycarbonylamino-3-trifluoromethylpyrazole, m.p. 182-183°C.

REFERENCE EXAMPLE 16

5 4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis-(phenoxycarbonyl)amino-3-trifluoromethylpyrazole used in the above Example 44 was prepared by following the procedure of Example 14, but replacing trimethylacetyl chloride by phenyl chloroformate. The  
10 title compound was obtained as a white solid, m.p. 168-169°C.

EXAMPLE 45

Compounds Nos. 105 and 106

15 5-Carbamoyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (3.57 g) was heated to 200°C with phosphorus pentoxide (2.82 g) with stirring. After 3 hours, the cooled product was treated with ice, and extracted with dichloromethane (3 x 50 ml). The organic solution was  
20 washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a solid. Recrystallisation from hexane gave 1-(2,6-dichloro-4-trifluoromethylphenyl)-4,5-dicyano-3-trifluoromethylpyrazole in the form of white crystals (1.8 g),  
25 m.p. 80°C.

By proceeding in a similar manner but replacing the 5-carbamoyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-3-carbamoyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonylpyrazole there was prepared:-

5-Amino-3-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonylpyrazole in the form of a white solid, m.p. 214°C.

#### REFERENCE EXAMPLE 17

5-Carbamoyl-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole used in the above Example 45, was prepared as follows:-

5-Carboxy-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (6.0 g; hereinbefore described in Example 43) was added to thionyl chloride (30 ml) and the stirred solution heated to reflux for 4 hours. The solvent was evaporated in vacuo, and re-evaporated after addition of dry toluene (30 ml). The resultant orange oil was dissolved in dry ether (10 ml) and added dropwise to a stirred solution of ammonia (0.88, 20 ml) cooled by an ice bath. After stirring overnight, water (150 ml) was added, and the mixture extracted with dichloromethane (3 x 50 ml). The combined extract was washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a white solid (7.0 g). Recrystallisation from a mixture of ethyl acetate and petroleum ether gave the title

compound (4.0 g), in the form of white crystals, m.p. 180-181°C.

5-Amino-3-carbamoyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonylpyrazole used in the above Example 45 was prepared by the same procedure, but by replacing the 5-carboxy-4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-3-carboxy-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonylpyrazole. The title compound was obtained in the form of an off-white solid, m.p. 223-224°C.

5-Amino-3-carboxy-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonylpyrazole used above was prepared as follows:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-ethoxycarbonyl-4-methanesulphonylpyrazole (8.15 g) was added to stirred 80% sulphuric acid (80 ml), and heated at 100°C for 5 hours. After cooling, the solution was poured onto ice, the solid filtered off and dried over phosphorus pentoxide in a vacuum desiccator. Recrystallisation from a mixture of methanol and petroleum ether gave the title compound as a white solid, m.p. 203-205°C.

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-ethoxycarbonyl-4-methanesulphonylpyrazole, used above, was prepared by the procedure of Reference Example 5, by replacing malononitrile by

methanesulphonylacetonitrile. The title compound was obtained in the form of a white solid, m.p. 255°C, after recrystallisation from ethanol.

#### EXAMPLE 46

##### 5 Compound No. 107

A solution of methylmagnesium iodide [prepared from magnesium (0.25 g) and methyl iodide (1.5 g) in diethyl ether (25 ml)], was treated with a solution of 1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-cyano-3-trifluoromethylpyrazole (2 g) in diethyl ether (20 ml), dropwise. The resulting pale yellow solution was refluxed for 24 hours, cooled, and treated with hydrochloric acid (2N, 10 ml). After stirring for 0.5 hour at room temperature, the reaction mixture was diluted with ether (50 ml). The ethereal extract was washed with water (50 ml), dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a yellow gum. This was purified by chromatography on silica (Merck, 230-400 mesh, 0.7 kg cm<sup>-2</sup>) eluting with a mixture of dichloromethane and petroleum ether (4:1) to give 4-acetyl-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole as a white solid, m.p. 134°C.

#### EXAMPLE 47

##### 25 Compounds Nos. 108 - 116

A stirred solution of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methylthio-3-trifluoromethylpyrazole (1.0 g) in chloroform (40 ml) was treated

with m-chloroperbenzoic acid (0.42 g), portionwise at room temperature. After stirring for 6 hours, the solution was diluted with dichloromethane and washed in turn with sodium sulphite solution, sodium hydroxide solution, and water. The solution was dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a yellow oil.

Purification by chromatography on silica (Merck, 230-400 mesh,  $0.7 \text{ kg cm}^{-2}$ ) eluting with dichloromethane-ethylacetate (4:1) gave 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methylsulphinyl-3-trifluoromethylpyrazole in the form of a white solid, m.p. 142-145°C with decomposition.

By proceeding in a similar manner but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methylthio-3-trifluoromethylpyrazole by the appropriate alkylthio phenylpyrazoles there were prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylsulphinyl-3-trifluoromethylpyrazole in the form of a white solid, m.p. 170°C from 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylthio-3-trifluoromethylpyrazole.

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylsulphinyl-3-methylpyrazole in the form of a buff solid, m.p. 157-158°C from 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylthio-3-methylpyrazole.



5-Amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylsulphinyphenyl)-3-trifluoromethylpyrazole, in the form of an orange solid, m.p. 76°C, from 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylthiophenyl)-3-trifluoromethylpyrazole.

4-Cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methylsulphonyl-3-trifluoromethylpyrazole, in the form of white crystals, m.p. 97-98°C, from 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-methylthio-3-trifluoromethylpyrazole.

By proceeding in a similar manner but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methylthio-3-trifluoromethylpyrazole by the appropriate alkylthiophenylpyrazoles, and employing 2 molar equivalents of m-chloroperbenzoic acid there was prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylsulphonyl-3-trifluoromethylpyrazole, in the form of white crystals, m.p. 206-207°C, from 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylthio-3-trifluoromethylpyrazole.

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylsulphonyl-3-methylpyrazole, in the form of a white solid, m.p. 193°C, from 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylthio-3-methylpyrazole.

By proceeding in a similar manner but replacing the 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methylthio-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-n-propylthio-3-methylpyrazole, there was obtained 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-propanesulphonylpyrazole in the form of a white solid, m.p. 145.5-147°C.

By proceeding in a similar manner there was prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-trichloromethanesulphonyl-3-methylpyrazole in the form of a pale pink solid, m.p. 183-184°C, from 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-trichloromethylthio-3-methylpyrazole.

#### EXAMPLE 48

Compounds Nos. 117, 118 and 119

A mixture of bis[5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole-4-yl]-disulphide (4.0 g), sodium dithionite (2.02 g) and sodium hydroxide (0.46 g) was stirred and heated under reflux in a mixture of ethanol and water (60 ml, 1:1) for 4 hours. The cooled yellow solution was treated with ethyl iodide (2.17 g) and the mixture stirred and heated under reflux for 2 hours. After evaporation in vacuo, the yellow gum was dissolved in ether (100 ml), washed with water, dried over anhydrous magnesium sulphate, and re-evaporated in vacuo. The

resultant gum was purified by chromatography on silica (Merck, 230-400 mesh,  $0.7 \text{ kg cm}^{-2}$ ) eluting with dichloromethane, to furnish 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylthio-3-methylpyrazole in the form of a white solid, m.p.  $117^{\circ}\text{C}$ , after recrystallisation from hexane.

By proceeding in a similar manner, but replacing the ethyl iodide by methyl iodide there was prepared:-

5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-methylthiopyrazole, in the form of a white solid, m.p.  $112^{\circ}\text{C}$ , after recrystallisation from hexane.

By proceeding in a similar manner but replacing the sodium hydroxide by sodium carbonate, and the methyl iodide by n-propyl iodide, there was obtained 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-n-propylthio-3-methylpyrazole in the form of a white solid, m.p.  $100-102^{\circ}\text{C}$ .

#### REFERENCE EXAMPLE 18

Bis[5-Amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole-4-yl]disulphide was prepared as follows:-

A solution of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-thiocyanatopyrazole (3.0 g; hereinafter described in Example 50) in a mixture of ethanol and water (1:1, 100 ml) was acidified by the addition of hydrochloric acid (10 N,

20 ml). The mixture was heated under reflux for 8 hours, concentrated to half volume in vacuo, cooled in an ice bath, and sodium hydroxide solution added until the pH reached 9-10. The precipitated product was filtered, washed with water, and dried in vacuo to furnish the title compound (2.62 g) as an amorphous yellow powder, m.p. 211-213°C.

#### EXAMPLE 49

##### Compounds Nos. 120 and 121

A solution of ethyl magnesium bromide, prepared from magnesium (0.57 g) and ethyl bromide (2.6 g) in dry diethyl ether (25 ml), was added dropwise to a stirred solution of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-thiocyanato-3-trifluoromethylpyrazole (5.0 g) in dry ether (50 ml) at -20°C. After stirring for a further 2 hours at room temperature, water (130 ml) was carefully added, and stirring maintained for 0.25 hour. The ether layer was separated, dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a yellow gum. Purification by chromatography on silica (Merck, 230-400 mesh, 0.7 kg cm<sup>-2</sup>) eluting with dichloromethane-petroleum ether (1:1) gave a product, which recrystallised from hexane to furnish 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-ethylthio-3-trifluoromethylpyrazole, in the form of white needles, m.p. 115-115.5°C.

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By proceeding in a similar manner, but replacing the ethyl magnesium iodide by methyl magnesium iodide there was obtained:-

5-Amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-methylthio-3-trifluoromethylpyrazole, in the form of a white solid, m.p. 108°C, after recrystallisation from hexane.

#### EXAMPLE 50

##### Compounds Nos. 122 and 123

10 A stirred mixture of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (0.7 g) and potassium thiocyanate (0.55 g) in methanol (15 ml) was treated with a solution of bromine (0.3 g) in methanol (2 ml) at 0-5°C. Stirring was maintained at this temperature for 1.5 hours, and the mixture was poured onto ice water, and brought to pH 9 by the addition of sodium carbonate. The product was filtered, washed with water and dried. Purification by chromatography on silica (Merck, 230-400 mesh, 0.7 kg cm<sup>2</sup>) eluting with dichloromethane gave 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-thiocyanato-3-trifluoromethylpyrazole, in the form of a white solid, m.p. 49-50°C.

By proceeding in a similar manner but replacing 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole by 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole there was obtained 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-thiocyanatopyrazole in the form of a white solid, m.p. 133.5°C, after recrystallisation from a mixture of hexane and ethyl acetate.

EXAMPLE 51

Compound No. 124

By proceeding in a similar manner to that hereinbefore described in Example 4, but replacing the 2,6-dichloro-4-trifluoromethylphenylhydrazine by 2,6-dichloro-4-methanesulphonylphenylhydrazine there was obtained:-

5-Amino-4-cyano-1-(2,6-dichloro-4-methanesulphonylphenyl)-3-trifluoromethylpyrazole in the form of white crystals, m.p. 270-272°C.

REFERENCE EXAMPLE 19

By proceeding in a similar manner to that hereinbefore described in Reference Example 1, but replacing the 2,6-dichloro-4-trifluoromethylaniline by 2,6-dichloro-4-methanesulphonylaniline, there was prepared:-

2,6-Dichloro-4-methanesulphonylphenylhydrazine in the form of white crystals, m.p. 163-166°C.

EXAMPLE 52Compound No. 125

To a stirred ice cold solution of 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methylpyrazole (2.0 g) in chloroform (40 ml) and pyridine (0.51 g) was added dropwise a solution of trichloromethanesulphenyl chloride (1.2 g) in chloroform (10 ml). The resulting brown solution was stirred at 0°C for 2 hours, then at room temperature for 2 hours. A further addition of trichloromethanesulphenyl chloride (0.5 g) was made and the mixture stirred for 2 hours at room temperature. Water (100 ml) and dichloromethane (100 ml) was then added and the organic layer washed with water (1 x 100 ml), dried over anhydrous magnesium sulphate and evaporated in vacuo to give a yellow gum (2.9 g). This was purified by chromatography on silica (Merck, 100-230 mesh, 0.7 kg cm<sup>-2</sup>) eluting with dichloromethane-petroleum ether (3:2) to give a white solid (0.98 g). Recrystallisation from hexane gave 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-methyl-4-trichloromethylthiopyrazole in the form of white crystals, m.p. 156°C.

EXAMPLE 53

Compound No. 126

m-Chloroperbenzoic acid (2.1 g) was added to a solution of 5-amino-4-cyano-1-(2,6-dichloro-4-trifluoromethylthiophenyl)-3-trifluoromethylpyrazole (2.3 g) in dichloromethane (20 ml) cooled to 10°C. After stirring overnight at room temperature, the solution was heated under reflux for 4 hours, cooled, and a further addition of m-chloroperbenzoic acid (2.1 g) made. The mixture was stirred at room temperature for 4 hours and heated under reflux for 4 hours. The cooled solution was washed with sodium bicarbonate solution (20 x 20 ml), then with water (2 x 20 ml), dried over anhydrous magnesium sulphate, filtered, and evaporated in vacuo to give an orange solid. Purification by chromatography on silica (Merck, 100-230 mesh, 0.7 kg cm<sup>-2</sup>) eluting with ethyl acetate-petroleum ether (1:9) gave 4-cyano-1-(2,6-dichloro-4-trifluoromethanesulphonylphenyl)-5-nitro-3-trifluoromethylpyrazole (0.5 g) in the form of an orange solid, m.p. 168-169°C.



EXAMPLE 54

Compound No. 127

To a stirred solution of diethylammoniumsulphur  
trifluoride (1.5 g) in dichloromethane (13 ml) cooled  
5 to  $-70^{\circ}\text{C}$ , was added dropwise under nitrogen a solution  
of 1-(2,6-dichloro-4-trifluoromethylphenyl)-4-formyl-  
3-trifluoromethylpyrazole (3.1 g) in dichloromethane  
(17 ml). After 1 hour at  $-70^{\circ}\text{C}$ , the mixture was  
allowed to stand at room temperature overnight, then  
10 poured onto excess iced water. Extraction with  
dichloromethane gave a solution which was washed with  
water (2 x), dried over anhydrous magnesium sulphate  
and evaporated in vacuo to give a brown oil  
(3.26 g). Purification by chromatography on silica  
15 (Merck, 40-230 mesh,  $0.7\text{ kg cm}^{-2}$ ) eluting with  
hexane-ethyl acetate (5:1) gave 1-(2,6-dichloro-  
4-trifluoromethylphenyl)-4-difluoromethyl-3-trifluoro-  
methylpyrazole (1.15 g) [from ethyl acetate-hexane] in  
the form of a pale yellow solid, m.p.  $88-90^{\circ}\text{C}$ .

20

REFERENCE EXAMPLE 20

A mixture of 4-cyano-1-(2,6-dichloro-  
4-trifluoromethylphenyl)-3-trifluoromethylpyrazole  
(5.0 g; hereinbefore described in Example 21) and  
formic acid (120 ml) was treated with Raney nickel  
25 (5.1 g) and the mixture heated under reflux  
overnight. After cooling, the mixture was filtered,  
and the filtrate diluted with water (900 ml) and  
extracted with dichloromethane (4 x 100 ml). The

combined extract was washed with sodium bicarbonate solution (2 x), then with water (1 x), dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a brown solid (3.7 g), m.p. 80-82°C. This was 1-(2,6-dichloro-4-trifluoromethylphenyl)-4-formyl-3-trifluoromethylpyrazole.

EXAMPLE 55

Compound No. 128

To a stirred solution of 5-amino-4-carboxy-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-trifluoromethylpyrazole (15.0 g; hereinbefore described in Reference Example 6) in dry tetrahydrofuran (50 ml) was added, under nitrogen, a solution of borane-tetrahydrofuran complex (1 Molar, 27.5 g) during 10 minutes keeping at -20°C. The solution was allowed to reach room temperature and stirred overnight. A further addition of the borane was made (10 ml), and the solution heated under reflux overnight. After cooling, a further addition of the borane (20 ml) was made, and the solution again heated under reflux for 4 hours. After cooling, sodium hydroxide (6 N) solution was added to pH 11, and the solution extracted with dichloromethane. The organic phase was washed with water, dried over anhydrous magnesium sulphate, and evaporated in vacuo to give a brown oil. Purification by chromatography on silica (Merck, 40-230 mesh, 0.7 kg cm<sup>-2</sup>) eluting with

hexane-ethyl acetate (2:1) gave 5-amino-  
1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methyl-  
3-trifluoromethylpyrazole (2.0 g), from  
toluene-hexane, m.p. 97-100°C, in the form of white  
5 crystals.

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10

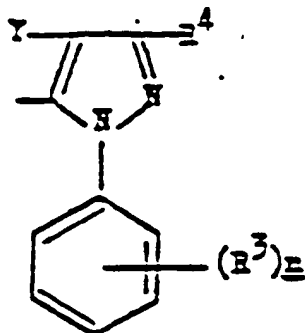
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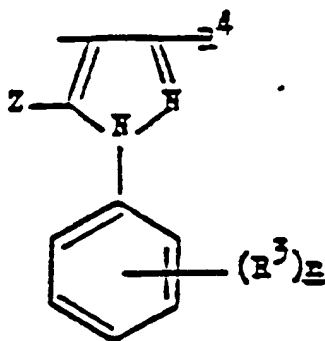
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In the following formulae it is to be understood that:

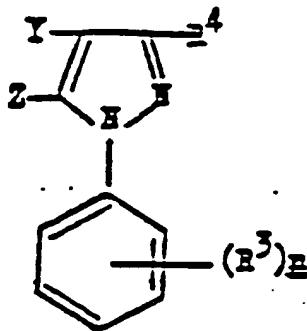
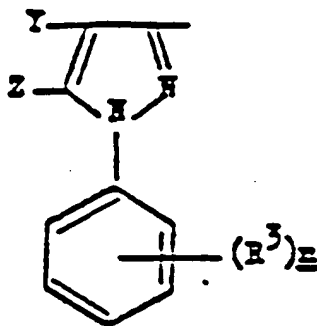
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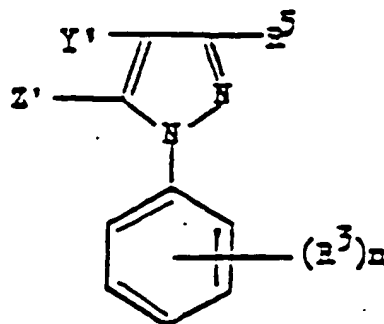
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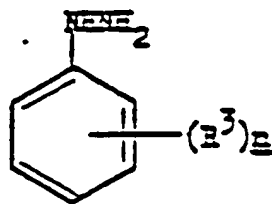
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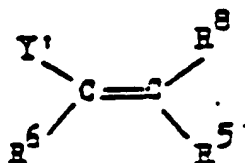
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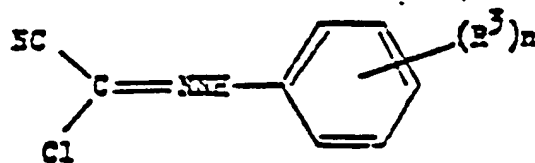
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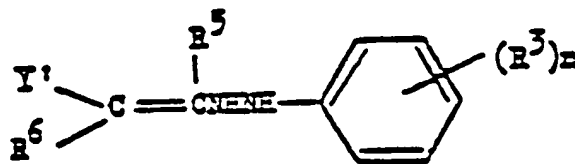
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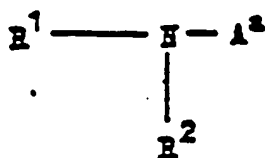
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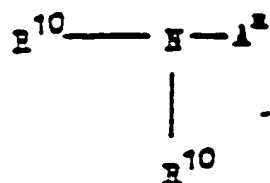
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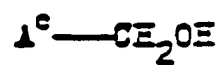
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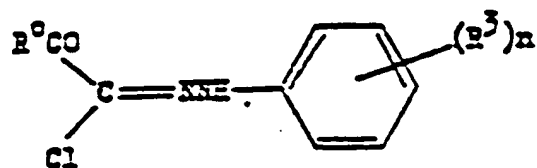
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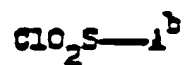
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XII



XIII



XIV



XV



XVI



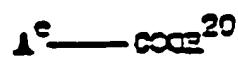
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XVII



XVIII



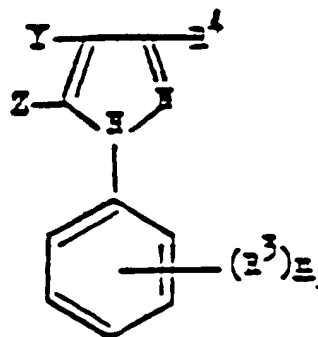
XIX



XX

CLAIMS

1. A method for the control of arthropod, plant nematode or helminth pests at a locus which comprises treatment of the locus with an effective amount of a compound of the general formula:



wherein Y represents a halogen atom, the cyano or nitro group or a group  $\text{RSO}_2$ ,  $\text{RSO}$  or  $\text{RS}$  in which R represents a straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms which is unsubstituted or substituted by one or more halogen atoms, a cycloalkyl group containing from 3 to 5 carbon atoms, a straight- or branched-chain alkenyl group containing from 2 to 6 carbon atoms, the thiocyanato group, the sulphanoyl group which is unsubstituted or substituted by one or two straight- or branched-chain alkyl groups which may be the same or different and contain from 1 to 6 atoms, the carbamoyl group which may be unsubstituted or substituted by one or two straight- or branched-chain alkyl groups which may be the same or different and contain from 1 to 6 carbon atoms, a straight- or branched-chain

alkoxycarbonyl group containing from 2 to 7 carbon atoms,  
a straight- or branched-chain alkanoyl group containing  
from 2 to 7 carbon atoms, or a straight- or  
branched-chain alkyl group containing from 1 to 6 carbon  
5 atoms which is unsubstituted or substituted by one or  
more halogen atoms, Z represents the hydrogen atom, or  
the amino group  $-NR^1R^2$  wherein  $R^1$  and  $R^2$ , which may be  
the same or different, each represents a hydrogen atom or  
a straight- or branched-chain alkyl group (containing  
10 from 1 to 6 carbon atoms, and which is unsubstituted or  
substituted by straight- or branched-chain alkoxycarbonyl  
of 2 to 5 carbon atoms), cycloalkyl group containing from  
3 to 6 carbon atoms, formyl group, straight- or  
branched-chain alkanoyl group (which contains from 2 to 7  
15 carbon atoms or together form a 5 or 6 membered cyclic  
imide with the nitrogen atom to which they are attached  
and themselves are unsubstituted or substituted by one or  
more halogen atoms) or cycloalkylcarbonyl group (which  
contains from 4 to 7 carbon atoms) or straight- or  
20 branched-chain alkoxycarbonyl group (which contains from  
2 to 7 carbon atoms and themselves are unsubstituted or  
substituted by one or more halogen atoms), or Z  
represents a straight- or branched-chain  
alkylsulphenylamino group containing from 1 to 4 carbon  
25 atoms, a straight- or branched-chain alkoxymethyleneamino  
group containing from 2 to 5 carbon atoms which is  
unsubstituted or substituted on methylene by a straight-



or branched-chain alkyl group containing from 1 to 4 carbon atoms, or represents a halogen atom, a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms, the carboxy group, or a straight- or branched-chain alkylthio, alkylsulphinyl or alkylsulphonyl group containing from 1 to 6 carbon atoms which is unsubstituted or substituted by one or more halogen atoms, or represents a straight- or branched-chain trialkylsilylmethyl group containing from 1 to 6 carbon atoms in each alkyl group which may be the same or different, a trialkylsilyl group containing from 1 to 6 carbon atoms in each alkyl group which may be the same or different or the cyano or nitro group,  $R^3$  represents a halogen atom, a straight- or branched-chain alkyl or alkoxy group containing from 1 to 4 carbon atoms which is unsubstituted or substituted by one or more halogen atoms, a straight- or branched-chain alkylthio or alkylsulphinyl group containing from 1 to 4 carbon atoms which is substituted by one or more halogen atoms, the nitro or cyano group or a straight- or branched-chain alkylsulphonyl group containing from 1 to 4 carbon atoms which is unsubstituted or substituted by one or more halogen atoms, and  $R^4$  represents a halogen atom, a cyano or nitro group or a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms which is unsubstituted or substituted by one or more halogen atoms, or a cycloalkyl group containing from 3 to 6

carbon atoms, and  $n$  represents an integer from 1 to 5 inclusive, and, when Z represents a carboxy group, salts thereof with pesticidally-acceptable bases, provided that  $R^4$ , Y and Z do not simultaneously represent three groups of the same genus selected from the genera (i) nitro, (ii) cyano, (iii) halogen and (iv) unsubstituted alkyl.

2. A method according to claim 1 wherein in general formula I  $(R^3)_n$  represents 2,4,6-trichloro, 2,3,5,6-tetrachloro, 2-chloro-4-trifluoromethyl, 10 2,3,5,6-tetrafluoro-4-trifluoromethyl, 2,6-dichloro-4-trifluoromethylthio, 2-chloro-3,5,6-trifluoro-4-trifluoromethyl, 2,6-dichloro-3,5-difluoro-4-trifluoromethyl, 2,6-dichloro-4-nitro, 15 2,6-dichloro-4-trifluoromethylsulphanyl, 2,6-dichloro-4-methanesulphonyl or 2,6-dichloro-4-trifluoromethanesulphonyl substitution.

3. A method according to claim 1 wherein in general formula I  $(R^3)_n$  represents 2,6-dichloro-4-trifluoromethyl 20 or 2,6-dichloro-4-trifluoromethoxy substitution.

4. A method according to any one of claims 1 to 3 wherein the compound of general formula I is 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3,4-dicyanopyrazole, 25 5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole, 4-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-5-bis

- (ethoxycarbonyl) amino-3-trifluoromethylpyrazole,  
5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-  
methanesulphonyl-3-methylpyrazole,  
1-(2,6-dichloro-4-trifluoromethylphenyl)-5-  
5 ethoxycarbonylamino-4-nitro-3-trifluoromethylpyrazole,  
5-amino-3-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-  
4-methanesulphonylpyrazole, or  
5-amino-1-(2,6-dichloro-4-trifluoromethylphenyl)-3-  
methyl-4-methylthiopyrazole.
- 10 5. An arthropodicidal, plant nematocidal or  
anthelmintic composition which comprises at least one  
compound of general formula I, or a pesticidally  
acceptable salt thereof, in association with one or more  
compatible diluents or carriers with the provisos that
- 15 (1) when the composition comprises a single compound of

general formula (I) wherein  $R^4$  and Z both represent methyl, Y represents thiocyanato and  $(R^3)_n$  represents 2-, 3- or 4-nitro, 4-methyl, 4-chloro or 2,4-dinitro substitution; or  $R^4$  represents methyl, Y represents cyano, Z represents unsubstituted amino and  $(R^3)_n$  represents 4-chloro, 2,4-dichloro, 3,4-dichloro, 3-chloro-4-methyl or 2-methyl-4-chloro substitution, the composition is not an association of a single compound of general formula I alone with water or a common organic solvent; (2) when the composition comprises a single compound of general formula (I) wherein  $R^4$  represents methyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3- or 4-fluoro substitution; or  $R^4$  represents ethyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3- or 4-chloro, 2-, 3- or 4-fluoro or methyl, 3-bromo or 3-nitro substitution; or  $R^4$  represents propyl, Y represents cyano or  $CONH_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3-fluoro substitution; or  $R^4$  represents methyl, Y represents sulphanoyl, Z represents chloro and  $(R^3)_n$  represents 4-chloro substitution; the composition comprises an agriculturally acceptable surface active

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agent or a feedstuff; (3) when  $R^4$  represents methyl, Y represents nitro, and Z represents chloro or  $R^4$  represents chloro, Y represents nitro, and Z represents methyl and  $(R^3)_n$  represents 4-nitro, the composition  
5 comprises a pharmaceutically acceptable adjuvant or a feedstuff or is substantially sterile and pyrogen-free or is in unit dosage form; and (4) excluding compositions comprising  
10 1-(4-nitrophenyl)-3-nitro-4-pyrazole-carbonitrile or carboxamide.

6. A compound of general formula I, wherein the various symbols are as defined in claim 1, and salts thereof, with the exclusion of the compounds wherein:  $R^4$  and Z both represent methyl, Y represents thiocyanato and  
15  $(R^3)_n$  represents 2-, 3- or 4-nitro, 4-methyl, 4-chloro or 2,4-dinitro substitution;  $R^4$  represents methyl, Y represents cyano, Z represents unsubstituted amino and  $(R^3)_n$  represents 4-chloro, 2,4-dichloro, 3,4-dichloro, 3-chloro-4-methyl or 2-methyl-4-chloro substitution;  $R^4$   
20 represents methyl, Y represents cyano or  $\text{CONH}_2$ , Z represents unsubstituted amino and  $(R^3)_n$  represents 3- or 4-fluoro substitution;  $R^4$  represents ethyl, Y represents cyano or  $\text{CONH}_2$ , Z represents unsubstituted amino and

yl, Y  
resents  
tion  
or  
en-free  
positions  
le or  
n the  
salts  
erein: R<sup>4</sup>  
yanato and  
-chloro or  
Y  
ino and  
chloro,  
tion: R<sup>4</sup>  
Z  
sents 3-  
represent:  
no and

(R<sup>3</sup>)<sub>n</sub> represents 3- or 4-chloro, 2-, 3- or 4-fluoro or methyl, 3-bromo or 3-nitro substitution;  
R<sup>4</sup> represents propyl, Y represents cyano or CONH<sub>2</sub>, Z represents unsubstituted amino and (R<sup>3</sup>)<sub>n</sub> represents 3-fluoro substitution; R<sup>4</sup> represents methyl, Y represents sulphamoyl, Z represents chloro and (R<sup>3</sup>)<sub>n</sub> represents 4-chloro substitution; R<sup>4</sup> represents methyl, Y represents nitro, and Z represents chloro or R<sup>4</sup> represents chloro, Y represents nitro, and Z represents methyl and (R<sup>3</sup>)<sub>n</sub>  
10 represents 4-nitro; and R<sup>4</sup> represents nitro, Y represents cyano or CONH<sub>2</sub>, Z represents hydrogen and (R<sup>3</sup>)<sub>n</sub> represents 4-nitro substitution.  
7. A compound according to 6 wherein (R<sup>3</sup>)<sub>n</sub> represents 2,4,6-trichloro, 2,3,5,6-tetrachloro,  
15 2-chloro-4-trifluoromethyl,  
2,3,5,6-tetrafluoro-4-trifluoromethyl,  
2,6-dichloro-4-trifluoromethylthio,  
2-chloro-3,5,6-trifluoro-4-trifluoromethyl,  
2,6-dichloro-3,5-difluoro-4-trifluoromethyl,  
20 2,6-dichloro-4-nitro,  
2,6-dichloro-4-trifluoromethylsulphanyl,  
2,6-dichloro-4-methanesulphonyl or

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2,6-dichloro-4-trifluoromethanesulphonyl substitution.

8. A compound according to claim 6 wherein  $(R^3)_n$  represents 2,6-dichloro-4-trifluoromethyl or 2,6-dichloro-4-trifluoromethoxy substitution.

5 9. A compound according to claim 6 which is

5-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3,4-dicyanopyrazole,

5-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-methanesulphonyl-3-trifluoromethylpyrazole,

10 4-cyano-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-5-bis(ethoxycarbonyl) amino-3-trifluoromethylpyrazole,

5-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-4-methanesulphonyl-3-methylpyrazole,

1-(2,6-dichloro-4-trifluoromethylphenyl)-5-

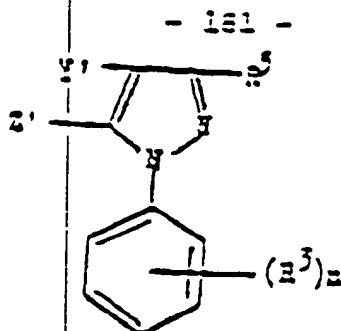
15 ethoxycarbonylamino-4-nitro-3-trifluoromethyl-pyrazole,

5-amino-3-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-methane sulphonylpyrazole or

5-amino-1-(2,6-dichloro-4-trifluoromethyl-phenyl)-3-methyl-4-methylthiopyrazole.

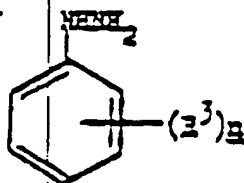
20 10. A process for the preparation of a compound of general formula I depicted in claim 1 wherein the various symbols are as defined in claim 6 which comprises:

(A) when the compound of general formula I conforms to the general formula:



wherein Y' represents the cyano or nitro group or a group  
 RSO<sub>2</sub>, RSO or RS, wherein R is as defined in claim 1, a  
 straight- or branched-chain alkoxycarbonyl group  
 5 containing from 2 to 7 carbon atoms, or a straight- or  
 branched-chain alkyl group containing from 1 to 6 carbon  
 atoms which is unsubstituted or substituted by one or  
 more halogen atoms, Z' represents the unsubstituted amino  
 group or a straight- or branched-chain alkyl group  
 10 containing from 1 to 4 carbon atoms, and R<sup>5</sup> represents a  
 fluorine, chlorine or bromine atom, the cyano group or a  
 straight- or branched-chain alkyl group containing from 1  
 to 4 carbon atoms which is unsubstituted or substituted  
 by one or more halogen atoms, or a cycloalkyl group  
 15 containing from 3 to 6 carbon atoms,

(1) the reaction of a compound of the general  
 formula:



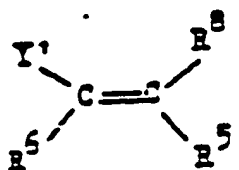
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wherein  $R^3$  and  $n$  are as defined in claim 1, or an acid addition salt thereof with (1), when  $R^5$  in the compound of general formula IA represents a fluorine, chlorine bromine atom, an optionally halogenated straight- or 5 branched-chain alkyl group containing from 1 to 4 carbon atoms or a cycloalkyl group containing from 3 to 6 carbon atoms, a compound of the general formula:

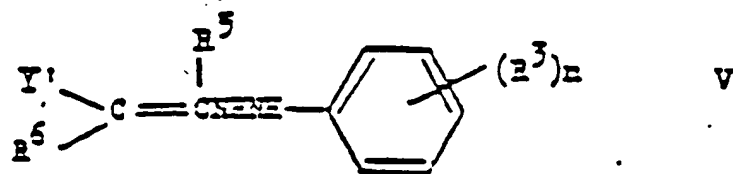


III

wherein  $Y'$  and  $R^5$  are as hereinbefore defined,  $R^6$  10 represents the cyano group or a straight- or branched-chain alkanoyl group containing from 2 to 5 carbon atoms and  $R^8$  represents a straight- or branched-chain alkoxy group containing from 1 to 4 carbon atoms, the hydroxy group or a fluorine, chlorine or 15 bromine atom, or

(2) when  $R^5$  in the compound of general formula IA represents the cyano group,  $Y'$  represents the cyano group and  $Z'$  represents the unsubstituted amino group, with tetracyanoethylene;

20 optionally isolating, before its cyclisation to the compound of general formula IA, the intermediate of general formula:

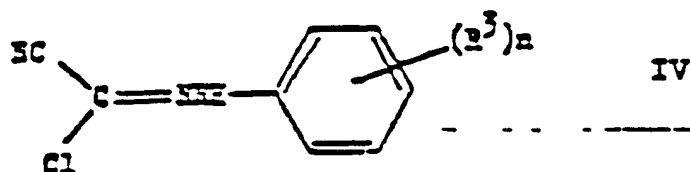


wherein  $\text{R}^3$ ,  $n$ ,  $\text{R}^5$ ,  $\text{R}^6$  and  $\text{Y}'$  are as hereinbefore defined, formed by reaction of a compound of general formula II with a compound of general formula III or tetracyano-ethylene;

(B) when  $\text{Z}'$  in general formula IA represents the unsubstituted amino group, by reacting a compound of general formula  $\text{Y}'\text{CH}_2\text{CN}$  with a compound of general formula II in the presence of a compound of the general formula  $\text{R}^7\text{C}(\text{R}^0)_3$  wherein  $\text{R}^7$  represents a straight- or branched-chain alkyl group containing from 1 to 4 carbon atoms which is unsubstituted or substituted by one or more halogen atoms or a cycloalkyl group containing from 3 to 6 carbon atoms and  $\text{R}^0$  represents an alkoxy group in an inert organic solvent at a temperature from ambient to reflux;

(C) when  $\text{Z}'$  in general formula IA represents the

unsubstituted amino group and  $R^5$  represents the cyano group by the reaction of a compound of the general formula



5 wherein  $R^3$  and  $n$  are as defined in claim 1, with a compound of general formula  $Y'CH_2CN$ , wherein  $Y'$  is as hereinbefore defined;

and preparing other compounds of general formula I by conversion, as hereinbefore described, of one or more  
 10 substituents  $Y$ ,  $Z$ ,  $R^3$  and  $R^4$ , or substituents corresponding thereto, into substituents  $Y$ ,  $Z$ ,  $R^3$  and  $R^4$  as defined in claim 1; and, when  $Z$  represents the carbonyl group, optionally converting a compound of general formula I into a salt thereof.

15 11. Intermediate compounds of general formula I wherein  $Y$  represents the hydrogen atom, the formyl or carboxy group, a straight- or branched-chain alkanoyl group containing from 2 to 6 carbon atoms which is substituted by one or more halogen atoms, the dithio group (which joins two pyrazole rings), the amino group  
 20

the  $-SO_2Cl$  group, a straight- or branched-chain  
carboxyalkyl group containing from 2 to 6 carbon atoms, Z  
represents the carbamoyl group or a straight- or  
branched-chain alkoxycarbonyl group containing from 2 to  
5 7 carbon atoms or the diphenoxycarbonylamino group,  $(R^3)_n$   
substitution is as defined in claim 2 or 3 or  $R^4$   
represents the amino, hydroxymethyl, carboxy or carbamoyl  
group or a straight- or branched-chain alkoxycarbonyl or  
alkoxycarbonylamino group containing from 2 to 7 carbon  
10 atoms.

12. A compound of general formula I as defined in  
claim 1, or a pesticidally acceptable salt thereof, for  
use in the manufacture of a medicament for the treatment  
of an arthropod or helminth infection.

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/GS 86/00781

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>4</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC <sup>4</sup> : A 01 N 43/56; A 61 K 31/415; C 07 D 231/38; A 01 N 55/00; C 07 F 7/08; C 07 D 231/44; C 07 D 231/40; C 07 D 231/18														
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; font-size: small;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border: none;"> <tr> <td style="width: 25%; border: none; vertical-align: top;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">           Classification System            IPC<sup>4</sup> </div> </td> <td style="border: none; vertical-align: top;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">           Classification Symbols            A 01 N; A 61 K; C 07 D; C 07 F         </div> </td> </tr> <tr> <td colspan="2" style="border: none; padding-top: 10px;">           Documentation Searched other than Minimum Documentation            to the Extent that such Documents are Included in the Fields Searched <sup>8</sup> </td> </tr> </table>			<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">           Classification System            IPC<sup>4</sup> </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">           Classification Symbols            A 01 N; A 61 K; C 07 D; C 07 F         </div>	Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>									
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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>														
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b> <table style="width: 100%; border: none;"> <tr> <th style="width: 10%; border: none; font-size: small;">Category <sup>6</sup></th> <th style="width: 70%; border: none; font-size: small;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>10</sup></th> <th style="width: 20%; border: none; font-size: small;">Relevant to Claim No. <sup>12</sup></th> </tr> <tr> <td style="border: none; vertical-align: top; padding: 5px;">P,X</td> <td style="border: none; vertical-align: top; padding: 5px;">           EP, A2, 0201852 (BAYER) 20 November 1986            see page 2, line 30 - page 4, line 19;            page 9, line 9 - page 12, line 2;            page 23, line 3 - page 33, line 24;            page 38, line 26 - page 40, line 28;            page 50, line 1 - page 54, line 17;            page 75, compound 66; page 90, compounds 192,193; claims         </td> <td style="border: none; vertical-align: top; text-align: center; padding: 5px;">1-12</td> </tr> <tr> <td style="border: none; vertical-align: top; padding: 5px;">P,X</td> <td style="border: none; vertical-align: top; padding: 5px;">           EP, A1, 0200872 (BAYER) 12 November 1986            see page 55, line 21 - page 64, line 19;            page 68, line 28 - page 72, line 27; claims         </td> <td style="border: none; vertical-align: top; text-align: center; padding: 5px;">1-3,5-8, 10-12</td> </tr> <tr> <td style="border: none; vertical-align: top; padding: 5px;">A</td> <td style="border: none; vertical-align: top; padding: 5px;">           Journal of Heterocyclic Chemistry,            volume 12, no. 12, December 1975,            Provo, Utah, US),            P.L. Southwick et al.: "Preparation            of 4,6-Diaminopyrazolo(3,4-d)pyrimidines            with variations in substitution at the 1- and 3-positions (1)",            pages 1199-1205            see tables IV,V            cited in the application         </td> <td style="border: none; vertical-align: top; text-align: center; padding: 5px;">1-12</td> </tr> </table>			Category <sup>6</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>10</sup>	Relevant to Claim No. <sup>12</sup>	P,X	EP, A2, 0201852 (BAYER) 20 November 1986 see page 2, line 30 - page 4, line 19; page 9, line 9 - page 12, line 2; page 23, line 3 - page 33, line 24; page 38, line 26 - page 40, line 28; page 50, line 1 - page 54, line 17; page 75, compound 66; page 90, compounds 192,193; claims	1-12	P,X	EP, A1, 0200872 (BAYER) 12 November 1986 see page 55, line 21 - page 64, line 19; page 68, line 28 - page 72, line 27; claims	1-3,5-8, 10-12	A	Journal of Heterocyclic Chemistry, volume 12, no. 12, December 1975, Provo, Utah, US), P.L. Southwick et al.: "Preparation of 4,6-Diaminopyrazolo(3,4-d)pyrimidines with variations in substitution at the 1- and 3-positions (1)", pages 1199-1205 see tables IV,V cited in the application	1-12
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<div style="display: flex; justify-content: space-between; font-size: x-small;"> <div style="width: 45%;"> <p><sup>13</sup> Special categories of cited documents: <sup>14</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to underline the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"Z" document member of the same patent family</p> </div> </div>														
<b>IV. CERTIFICATION</b> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;">           Date of the Actual Completion of the International Search         </td> <td style="width: 50%; border: none; vertical-align: top;">           Date of Mailing of this International Search Report  <div style="font-size: large; font-weight: bold; text-align: center;">21 MAY 1987</div> </td> </tr> <tr> <td style="border: none; vertical-align: top;">           International Searching Authority  <div style="text-align: center; font-weight: bold;">EUROPEAN PATENT OFFICE</div> </td> <td style="border: none; vertical-align: top;">           Signature of Authorized Official  <div style="font-weight: bold; text-align: center;">M. VAN MOL</div> <div style="text-align: center;"> </div> </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report <div style="font-size: large; font-weight: bold; text-align: center;">21 MAY 1987</div>	International Searching Authority <div style="text-align: center; font-weight: bold;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Official <div style="font-weight: bold; text-align: center;">M. VAN MOL</div> <div style="text-align: center;"> </div>								
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# INTERNATIONAL SEARCH REPORT

International Application No. **PCT/G2 86,**

**I. CLASSIFICATION OF SUBJECT MATTER** (If several classification symbols apply indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC  
**IPC<sup>4</sup>: C 07 D 231/16; C 07 D 231/14; C 07 D 231/12;**  
**C 07 D 403/04**

## II. FIELDS SEARCHED

Minimum Documentation Searched \*

Classification System 1

Classification Symbols

**IPC<sup>4</sup>**

Documentation Searched other than Minimum Documentation  
to the extent that such documents are included in the Fields Searched \*

## III. DOCUMENTS CONSIDERED TO BE RELEVANT \*

Category *	Citation of Document, * with indication, where appropriate, of the relevant passages **	Relevant to Claim No. 13
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- |    |   |      |
|----|---|------|
| A  | US, A, 3760084 (J.W. MARSICO, Jr. et al.)<br>18 September 1973<br>see claims<br>cited in the application  | 1-12 |
| -- |   |      |
| A  | US, A, 4145554 (R.G. JONES) 20 March 1979<br>see column 2, line 40 - column 5,<br>line 51; column 6, lines 3-12, 17-26,<br>31-40; column 37, line 33 - column 38,<br>line 32<br>& US, A, 4066716 (cited in the application)                     | 1-12 |
| -- |   |      |
| A  | Il Farmaco - Ed. Scientifica, volume 38,<br>fasc. 4, April 1983, (Pavia, IT),<br>P. Giori et al.: "Synthesis and<br>antifungal activity of pyrazole<br>derivatives containing sulfurated<br>functions", pages 274-282<br>see the whole document | 1-12 |
| -- |   |      |
| A  | AU, A, 508225 (COMMONWEALTH SCIENTIFIC<br>AND INDUSTRIAL RESEARCH ORGANISATION)<br>13 March 1980, see claims  | 1-12 |

\* Special categories of cited documents: --

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "I" earlier document but published on or after the international filing date
- "T" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"L" later document published after the international filing date or priority date and not in conflict with the application but cited to underline the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being deemed to be a person skilled in the art

"Z" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search

**13th April 1987**

Date of Mailing of this International Search Report

International Searching Authority

**EUROPEAN PATENT OFFICE**

Signature of Authorized Officer

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US, A, 2998419 (C.L. DICKINSON et al.) 29 August 1961, see example -8; column 11, lines 14-20; claims 19,20	1-12
A	US, A, 3423424 (D.L. TREPANIER) 21 January 1969 see the whole document	1
A	Chemical Abstracts, volume 91, no. 25, 17 December 1979, (Columbus, Ohio, US), see page 181, abstract 205651p, & JP, A, 7984032 (ISHIHARA SANGYO KAISEA, LTD.) 4 July 1979	1,12

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 27/04/87

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Patent document cited in search report	Publication date	Patent family member(s)
EP-A- 0201852	20/11/86	DE-A- 3602728 JP-A- 61262671 AU-A- 5736286
EP-A- 0200872	12/11/86	DE-A- 3509567 JP-A- 61215371
US-A- 3760084	18/09/73	None
US-A- 4145554	20/03/79	US-A- 4066776 NL-A- 7203453 FR-A, B 2130276 DE-A- 2212080 GB-A- 1352227 AT-B- 323156 CA-A- 998055 CH-A- 529631 CH-A- 590239 BE-A- 780675 OA-A- 4074 AU-A- 4002072 AU-B- 462250
AU-A- 508225	13/03/80	None
US-A- 2998419		None
US-A- 3423424	21/01/69	None

For more details about this annex :  
see Official Journal of the European Patent Office, No. :